in the troposphere are larger than those of the N.H. station. Other explanations for a secondary ozone

peak in the imposphere are presently under investigation. Among these, meteorological processes may be important and possibly also a strong variation with height of the eddy dif-

No definitive answer can be given presently for our title question, but the ilata gathered so far at Natal show larger tropospheric ozone densities than thuse measured in Panama, which contradicts previous results. This occurs ilespite lower densities of CH<sub>1</sub> and CO

expected in the S.H. and is related, perhaps,

to differences in the nitrogen oxide densities. On the other hand, the secondary tropo-

spheric ozone peak in the data may imply the

There is an abvious need for additional mea-

I am grateful to 1. J. Kantor, Y. Sahai, and

B. Clemesha for useful discussions, A. Motta and J. Alves are responsible for the Natal op-

erations, and at the Natal range thanks are

Azamhnja and his Air Force personnel. The

Nami data have been collected under a prin-

gram of cooperation between INPE, the Bra-

zilian Institute for Space Research, and NASA. I thank E. Hilsenrath, A. Hulland, A.

Turres, R. Barnes, and A. Grothwose for

their interest and support. This work was

partly supported by the Fonds Nacional de Desenvolvimento Cientílico e Technológico

Chameides, W., and J. C. G. Walker, Possible

variation of azone in the troposphere dur-ing the course of geologic time, Am. J. Sci., 275, 737–752, 1975.

under commet FINEIS537/CTL

due to commanding officer Columel Sidney

presence of a tropospheric ozone source.

fusion coefficient.

Acknowledgments

Eos, Transactions, American Geophysical Union

for change one notice hip record a

1.5

Grue AGU
your new addre
Please allow up to 6 weeks fo
be effected if mailed. Only or
needed for AGU membership
all AGU subscriptions. Retm
panel, with label, to:
American Geophysical Unior
2000 Florida Avenue, N.W.
Washington, DC 20009

Meteorology

111d Boundary layer structure and gracessos

MEGOCALE VARIABILITY IN MABISE MUNDS AT Mid-LATITUDE

3. E. Overland libertin Marian desironess cal laboratory,

Mod., 1600 Sond Point Musy Mr. 518 C15700, Senttin,

Ma., 48114-00701, J. G. Wilson

Wind data wate no liberted by the ROAA MP-1D strong

on lowel 150 and 40 ml, rense and olong-meanwind

states of adproximately 150 th during the Store Transfer

and Presonar Experient 137821 is November and Desember

1406. Observed representative that the merian

wind Dirido are characterised by the velority

converting towar for three atmospheria regiment

claud stronts, opes and closed relinite removertion,

and prelionate were six advertion. The dominant accel
six escussion timusation in the wind liteld anomal

ac the mean wind direction in the case of cold

continental air flowing over a waveer organ, producing

riout attents, was fix to Text this case the cold

deviation in momentom cransfer, which was calculated

deviation in momentom cransfer, which was calculated

from 8 in submets of the light truth by the bulk

serudyssuic method sessoning a securet drag coelficient,

is 11 of the sponditic-acula lillo bul mean. The

deviated aculation was 82 in and for elosed callular

conserving mathod sessoning a securet drag coelficient,

in the open aculation was 82 in and for elosed callular

conserving aculation was 82 in and for elosed callular

conserving aculation was 82 in and for elosed callular

conserving aculation feeder liber advertion ones

bet on examination assertion liber a 15% to flight

tract constant drag acefficient for a 15% to flight

tract constant assertion sessor in advertion ones

bet on accentration tessor, which can be a second to exituate

measure. Service acute and liber action of the

conserve regime separation occlimate. This general

and weather regime separation occlimate. This penoral

contraction is consistent to the conservation of the

conservation aculation tessor all well only it action of the

conservation aculation the

Geomagnetism and

J. Georgiaa. Res., U. Papar 485455

Meteorology

Paleomagnetism

Vol. 65, No. 29, Pages 441-448

length acalon, i.e. cells or rolly, on contracted with a rolling in accurrately describe regional winds and luxus at the see surface, wind accurate and temperature dura should be everaged over the dominant mesoscale length axis cither with a mitrable time everage or spetial everage, such as can be obtained by secturements, or se entirely all the mesoscale vertically stated. It is nine suggested that contends of the principle vital of the corneit nived layer occurs at length spelms of nineaphosis bacodery layer structures. (Mesoscale vertability, callular convertion, riold structure. 2330 Sestial Veriaticas (Georeguetic)
18E 8788-GARAM RAGNITIC 18ECO Al 1980 DEFCRMINGA FROM
180581 dtlA
7. A. Langut 18ullard Caboretorist, University of
2. A. Langut 18ullard Caboretorist, University of
Carbridge, Cumbridge GB1 DEA, U.K.), A.M. Eatee
Date Jeon the Ragsal adetarrals for Novecder 1919
through 1952 are used to derive expherisel harmonic
model of the aerth's main eagnetic tield end its
secular variation at apoch 1980.0. The codel is satisf
dSICTIZ/S31. Forefunt coefficients ere determined
through degree and order 13 and secular vertation
to all islents through degree and order 10. The linst
degree external Terms end torratdonding induced
internal terms are given as a Junction of fast.
Preliatary modeling using saperate data acts at deen
and dott losal ties showed that the dusk data conteins
to tubstantial lield sontribution iron the equatorial
alattrolat current. The linal date sat was therefore
selatted Jirat Isse dawn dete and these augmented by
dust data to athlere e good geographic deta
distribution for each of three time darlight
111 Sowaber - Desember, 1979; 121 January - february,
1980; 131 March - 8drll, 1980. A correction to the
advated of the equatoried elestrolat was applied to the
dust dale utilized. The solution included ratualation
of tised bisses, or amonalize, for the observatory
oata, Although shallar in asymptopesta, 657(1275)
dillers iron ICRF 1980 by 3.4 at in tae d,
1erc end
shows a slightly negative B in the nethern doter
regros as well as other differences in setuler
setation pattern. IGaoreguetic 11ald, Sagast,
shervice harmonit models!

to maply so down to finder destate.

1. Grobins. 4.2., ..., finer 4.415.

3760 lonic lactractions (Tropompharic lim Sampliant)
FIRST MASS SPECIANCE SIC MEASUREMENTS OF AIMMORIBERY
N. D. Perhima 1850/RM/RES, "Saergle limitation of
lechoology, Atlanea, Georgie 103121 and F. L. Etecle
Squarelly accurring positive end negative limitation of
repomphare have been made 1degilled at Repole latitud,
Cenzie and Mr. Evans, Colorado. Thems measurements
have made et ground level under a veriety of meetice
conditions. Over the course of the aspectiment, positive
togs were each at cases 54, 60, 80, and 94 ANU. Heen
Of ANU to be lived to be NH. \*: 28,001. In the negative
epsitum ions were absented at the mease 42, and 125
ANT and are believed to be ND., and NO. 'IRNOL'.
Several ions which appear to Bo R.Q clorkors of the
ebove tone were also observed. These are the first
escouroments of the meet identify 11 ANU resolution of
naturally accurring tune in she tropomphore with the
esception of a previous measurements which is
losted made range is as urbon sevicoment [Elanle,
lat. J. Manu. Spec. Ion Prox., 32, 119, 1981]. Ionu
that were artificially glodicard were alan studied and
curpored to the mich longer lived natural loss. 110ne,
troposphatic assignments, made spect remotery.

J. Yrophia. Mos., p., Paper 400377

3770 Porticine and Adresola DEADVIOLOTTIE ROWAL HEAD APPOSOL EXTINCTION NATIO AND UTS RELATIONSHIP WITE ZOURL MEAN TEXPERATURE EMPING THE MULTICE 1078-1079 STRATOSPHERIC HAPMING
Pi-thos Many limitious for Atmospheric Optics and depots Source 2, Name 2, Manager 10, 2166-64

denote Someting, P. O. Box, P. Manpion, VA 236661. M. d. HoCornick And the Cornick

The behavior of the somet was secretal actination
rates in the lower structure as an 75° and its relationable with the monal mean temperature during the
Demacy-February 1679 structure during the
Demacy-February 1679 structure during the
Demacy-February 1679 structure and sensor GAN It
istrates pharts Associ Hensurement end auxiliary
retreasofogical measurements. The results indicate
that distinct changes in the somet some account estimation tactio occurred during this etrecompheric sudden
turning. In purctualer, the results ascent construction tactio occurred during this etrecompheric sudden
turning. In purctualer, the results ascent concurrent
rapid increase of mean advanced entiretion resion and
mean temperature from Pabruary 17 to February 27. It
is also found that horizontal addy transport due co
plasstary waves may have played a significant role in
determining the distribution of the monal bees serosol
extinction ratio.

J. Geophys. Res., F, Paper 400890 

a coefficient for a 18% to fight both call type was 18% of the same air advection ones canagesh variability.

a model at the Sorthestal volocity of the same air advection ones canagesh variability.

a model at the Sorthestal volocity of the same air which cas be used to estimate the test of the charge of the case of the charge of the control of the same air value for the coefficients. This percent is presented to the same air value of t

### Particles and Fields-Ionosphere

Denosphere

2310-filch Lattindu Lonospheric furrants
Emethwaro herectiv their many free springs of Child.

P. F. Sylhrou (Lune hopkins listvertisfigite)

Physics Laboratory, Laurel, Meryland 19701,

Au Intense (Pag. Aginel), Meryland 19701,

1871, It see horelt of the austorest edge of large-coals certhord-floating current in the large-coals eartheat for the austorest edge of large-coals certhord-floating current large in the season of the current large of the first hard floating for the large-coals certhord-floating current large in the season of large-coals cattent for the Alf Langer show that the lattan-coals current for the season cattent for children wearing coansist in the range of a 'y to 29 pre latters in the season catter? I is — 0.75 seas. This latters is the large cattent in the range of a 'y to 29 pre latters in the season of elystem of coactic field (- Weeth, presente of polareon conductivity [7]). In the presente of elystem in the laboraphyric conductivity in the ship recented the the infarred high dendity sources.

Nosuurament of horizottel los drift fam bright for 10 hr os both sides of the region of fixed in the latters of horizottel los drift fam bright of 10 hr os both sides of the region of fixed denotify [7] in C. Teld<sup>2</sup>(cat thus, If a 'y decellel electron defit velocity derical in y 'y decellel electron defit velocity derical in a 'y decellel electron defit velocity derical in y 'y decellel electron defit velocity derical in y 'y J. Goopliye. Res., A. Paper 450562

J. Googhya. Res., A. Paper and My Incre)
UNIFORMLY STATES FIELD-ALIGNED LOWIZATION DOTS

B. H. Gross (Jolytachnic Tostituts of New York.)
Long beland Centes, Route 110. Ferningdis, S.1. [172]
Long beland Centes, Route 110. Ferningdis, S.1. [172]
Department of Communications Greave, Operating the My and IP sadio save signals transmitted from the My and IP sadio save signals transmitted from the State of Communications of My and the State of Communication of My and the State of Communication of My and the State of Communication of traces observed by balow the setalitie. The seculting states of the State of Communication of traces observed authors of Cases, of Combination-mode traces observed authors of Cases, of Combination-mode traces of the Formation of Cases, of Combination of traces observed authors of Cases, of Cases, of Combination of traces of the Formation of the State o

Tr. Georgias, Sear L Value Vy Con Victor

# Are Northern Hemisphere Tropospheric Ozone Densities Larger?

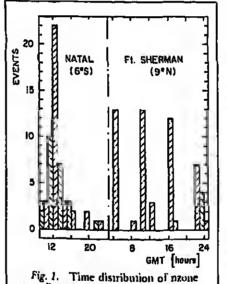
Volker W. J. H. Kirchhoff Instituto de Pesquisas Espaciais INPE, São Paulo, Brazil

Tropospheric ozone densities at two tropical stations are compared. Contradicting previous evidence, the southern hemisphere measurements show ozone densities larger than those collected at the northern hemisphere station.

It has been claimed that northern hemisphere (N.H.) tropospheric ozone densities in the tropics are higher than those measured at southern hemisphere (S.H.) stations [Fishman et al., 1979, and references therein]. It is implied that such a result would be normally expected due to higher concentrations of hy-drocarbons in the N.H., especially methane and carbon monoxide, therefore favoring the production of ozone [Chameides and Walker, 1975] through the so-called methane axidation reaction chain (or its equivalent, starting from CO). Attractive as this idea is, we must point to a priori contradicting evidence, which shows larger ozone densities in the

We have analyzed two independent data sets, one from Fi. Sherman, Panania (9°N), and die other from Natal, Brazil (6°S). Both data sets have been gathered using balloonboroe ECC ozonesoniles. Several other aspects of the Natal data have been discussed by Kirchhoff et al. [1881] and Kirchhoff et al.

The number of measurements and their distributions in time are shown in Figure 1. The Naial data have been gathered mostly around noon UT, over a period of about 3 years (1979-1981), following a schedule of about two launchings per month to provide ground truth for overhead satellite passages whereas the Ft. Sherman data have been col lected in a fast sequence during a special NASA campaign during the month of July 1977. The Panama station is located within



soundings at Natal and Ft. Sherman.

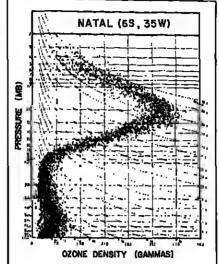


Fig. 2. Mass plot of ozone data taken at Natal. Abscissas are expresed in gam-

the Intertropical Convergence Zone, whereas Namil is not.

Figure 2 shows a mass plot of the Natal rizone data as a function of annuspheric pressure. The abscissa gives uzone densities expressed in gammas (µg/m²). A rendency for the formation of a secondary uzone peak in the lower troposphere can be clearly seen at 600-700 mbar. In terms of tropospheric acronomy, this can be explained through a tropospheric ozone source, if the eddy diffusion coefficient is constant in the proposphere. More discussion on this point is given after Figure 4, which shows the average ozone density profile based on this set of data.

Fishman et al. [1979] have concluded that there is a real hemispheric difference in the densitites of tropospheric ozone in the trop-ics, in which larger values would be found in the N.H. This conclusion was reached in part on the basis of the data then available (43 soundings from Panama, 31 from Canton Island (2°S), and 10 from La Paz (16°S)), reproduced in Figure 3 by the continuous lines. The abscissas show mixing ratios by volume as a function of height. Our results for Natal and Ft. Sherman (shown by triangles and eircles, respectively) clearly contradict the earlier results. It should be noted that the continues has determined by the property of the short ways obtained using different ous line data were obtained using different types of ozonesondes, whereas for the data that we present the same types of sondes and the same data reduction techniques were used, which probably can justify a lesser de-

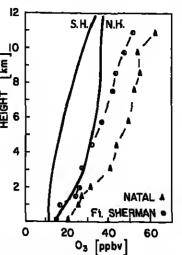


Fig. 3. Comparison of ozone mixing ratios used for northern and southern hemisphere comparisons and the ilara analyzed in this work for Natal and Ft. Sher-

gree of confidence in the earlier data. In Figure 4 we show the tropospheric ozone density probles in terms of oznne concentrations as a function of height. The size of a typical standard deviation is shown by the horizontal bar. Again it is clear that the S.H. station (Natal) slinws more name than the Panama station. But the point we want to stress in this ligare is the presence of a peak of the azone density in the lower troposhero

If it is assumed, as is usual, that the citily diffusion coefficient K is constant in the traposubere it is easy to see that these profiles cannot be reproduced by the usual constant this models. Applying the diffusion equation [//unten, 1975].

Fishman, J., S. Sidomon, and P. J. Cruizen.  $\psi = -K(dn/dz + n/H)$ (where u is the ozone density. H is the ilen-Observational and theoretical evidence in sity scale height, and  $\psi$  is the ozone thix) at a support of a significant in-situ photochemipoint above and below the density maximum cal source of troposphere ozone, Telha, 31. i is clear that below the peak the downward 432-446, 1979, flux of ozone must be larger than at any Hunten, B. M., Vertical transport in annospheres, in Atmospheres of Earth and the Phorets, cilited by B. M. Mr Cormack, pp. isbpoint above it. In other words, a local source of ozone at about the height of the peak must

 D. Realel, Hingham, Mass., 1975.
 Kirchholl, V. W. J. H., Y. Saloi, and A. G. exist for the extra supply of azone. Thus, the basic argument of Fishman et al. [1979], than Motta, First ozonic profiles measured with ECC soudes at Natal (5.988, 35.98W). there is an in sim photochemical source of ozone in the triquisphere is not challenged, although in this case the S.11, ozone densities

Geophys. Rev. Lett., 8, 1171-1172, 1981. Kirchholf, V. W. J. H., E. Hilsemath, A. G. Motta, Y. Saliai, and R. A. Medrano-B., Equatorial ozone characteristics as measured at Natal (5.9°S, 35.2°W), J. twophys. Res., 88, 6812-6818, 1983.

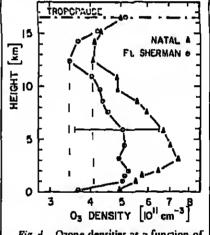


Fig. 4. Ozone densities as a function of height for Natal and Ft. Sherman with evidence of a peak in the lower troposphere.

Volker W. J. H. Kirchoff obtained his Ph.D. in 1975 at The Penntylvania State University, Emploved by the Brazilian Institute for Space Research (INPE) since 1970, his basic interests have been atmospheric research in the ionosphere and wesosphere as well as leaching in

INPE's graduate student programs in space sci-rnce. Most of his publications have been on the atmospheric sodium layer. In 1978 he helped to start a long-term ozone measurement program at Natal in caoperation with NASA and ever since has been deeply involved in this resaerch area.

# News

# The NASA STE Project

The NASA Upper Atmosphere Research Program has funded a multi-year, multi-mission project, the Stratosphere-Troposphere Exchange (STE) Project, whose goal is to improve our understanding of the processes by which trace constituents are exchanged between the stratosphere and troposphere. The project is managed by the Almospheric Ex-Perimenta Branch, NASA Ames Research Center. Project scientist is E. F. Danielsen, and project manager is P. B. Russell, both of Ames Research Center. Scientific guldance is provided by an executive committee chaired by J. R. Holton, University of Washington. Project plans call for five major missions using the NASA U-2 and ER-2 high altitude aircraft in the extratropics, the subtropics, and the equatorial region in the years 1984

Although stratosphere-troposphere exchange has been studied for a number of years, the relative roles of bulk advective orerturning (the so-called Brewer-Dobson cell) and eddy mixing on scales ranging from planetary waves to convective clouds and small scale turbulence remain controversial The objectives of the project include identify-

ing and quantifying both upward and downward tracer transfer processes with special emphasis on the mechanisms for water vapor transport into the stratosphere.

ER-2 research alreraft. The aircraft will be equipped with a meteorological measurement system including an inertial platform and air motion sensors. Fast responding in situ sensors will measure ozone, total odd nitrogen, carbon monoxide, water vapor, and total water (vapor plus evaporated ice crystals), condensation nuclei, small and large aerosols, and the two-dimensional image of ice crystals. Potential vorticity will be computed from the wind shears (flying perpendicular to the flow) and the stability measured by n vertically scanning microwave radiometer. Also, for anvil cloud studies two infrared radiometers (one broad band with 2n viewing angle, operating in a vertical filpping mode, and the other a narrow band, narrow solid angle operating in a downward-looking mode) will pro-vide measurements to assess radiative cooling rates above and in the upper portion of the

Flights in the extratropical stratosphere planned for spring 1984, autumn 1985, and spring 1986 will study exchange associated with upper tropospheric jetstreams. Flights will be directed normal to the axis of a jet

stream and/or across multiple jets 10 measure and correlate the mixing ratios of trace gases and aerosols with one amother and with the quasi-conservative potential vorticity. Air of The project field missions will rely on new-stratospheric origin will be identified by ly developed instrumentation for the U-2 and tive correlations between potential varticity. ozone, total odd nitrogen, and aerosols containing railloactive beryllium 7 and phosphorous 32. Conversely, negative correlations are expected between the above tracers and carbon monoxide, water vapor, condensatinn . nuclei, and railon. Initial flights will determine spatial variabilities; subsequent flights in the extratropics and tropics (see beluw) will be designed to measure fluxes and to study the transfer processes.

Cloud oriented flights in the tropical stratosphere are planned for January 1987, following a practice mission in the sutnmer of 1986 above a large cumulonimbus auvil, probably over the mountains of Colorado. These flights will be oriented particularly toward attempting to understand the dynamics of water vapor transport into the stratosphere in solve the puzzle of the extreme aridity of the stratosphere. Previous experiments conductd with the NASA Ames Research Center U-2 In the Panama Canal Zone have shown that the Brewer "freeze dry" mechanism for deliydrating the stratosphere is not adequate to explain the very low observed mixing ratios near 19 km in Panama. A deliydration mech-

Lett., 9, 605-60B, 19B2) will be tested by flying over and descending into the upper por-tion of a dense clams anvil which is assumed to torm in the lower atn phere. The denv dration mechanism depends upon strong radiative cooling at the anvil's inp, plus radia tive heating at its base to maintain a turbulent upward vapor flux, ripld ice crystal growth n supersaturated vnpor near the top, and a downward flux of ice crystals from the anvil base. In addition, flights will be designed to ten the dehydration potentials of slow as-cending mollons identifiable by the presence of a thin ice ervstal eloud.

anism proposed by Danielsen (Geophys. Res.

The major experiment of the STE project series is proposed to be canducted in the Micronesinn area using a base in northern Australia. This reglun and time of year have been selected because they include the enidest and highest monthly mean tropopause temperatures. These conditions, which are associated with intense cumulonimbus convection and massive cirrus anvils, are thought to be ideal for dehydration of air entering the stratosphere.

Plans are still being formulated for ancillary measurements to support the ER-2 flights during the Micronesian experiment. Enhanced satellite coverage, surface-based re-

News (ront. on p. 450)

**September 7-8, 1984 Oregon State University** Corvallis, Oregon

Convenors: Robert A. Duncan & Shaul Levi

Abstract Deadline August 1, 1984

(Call for Papers was Published in Eos, June 12)

For information on the abstract formal or other meeting logistics contact:

Meetings Department American Geophysical Union 2000 Florida Avenue, N. W. Washington, D. C. 20009 Telephone (202) 462-6903

For program information contact:

Robert Duncan College of Oceanography Oregon State University Corvallis, Oregon 97331

News (ront, from p. 449)

100

 $-\frac{1}{2}g_{\mu}^{2}(\theta)g_{\mu}^{2}(\theta)$ 

more sensing, and ballouse-based measurements would all be useful. Scientists interested in possible partiripation should contact the project manager, Philip B, Russell, Chiel, Atmospheric Experiments Brauch, 245-5, NASA Ames Research Center, Mnffett Fiekl, CA 94035.

This news item was contributed by James R. Halton, University of Washington, and Edwin F. Daulelsen oud Philip B. Russell, NASA Ames Re-

# Upcoming Hearings in Congress

The following heasings and narkups have been tennatively teheduled for the coming weeks by the Senate and House of Representatives. Dates and timer should be verifued with the committee or subcommittee holding the hearing or markup; all others on Capitol Hill may be reached by relephoning 202-224-3121. For guideboes on contacting a roumber of Congress, see AGU't Guide to Legislative Ixformation and Canturis (Ees. April 17, 1984, p.

July 26: Tentative schedule of marking of Uniform Science and Technology Research and Development Utilization Ad (H.R. ams) by the Science, Research, and Technology Subseminitee of the Hisuse Science and Technology Committee, Rayburn Building, Room 2318, time to be announced.

July 26 and July 31: Consecuence on the Export Administration Act reauthorization (S. 979), Joly 26, Raylairn Building, Ruom 2172, 2:30 P.M.; July 31, the Capitol, Room S-207, 3:00 P.M.

July 26: Hearing on UNESCO by the International Operations Subcommittee of the Hoose Foreign Alfairs Committee. Time end runni to ke announced.

TBA: Conference nn legislation to consolidate and authorize certain atmospheric and satellite programs and functions of the /Natirmal Oceansic and Atmospheric Administration. Date, time, and rount to be annomred.—*BTR* 

# Marginal Ice Zone

A middidisciplinary team of scientists, including mercorologists, occamigsaphers, physicists, and biologists from mure than 10 countries, are in the process of wrapping up a study of ice packs and their relationship to connect of the East Greenland Sea. The sturty, known as the Marginal Ice Zone Experiment (MIZEX '84), continues and expands on last February's MIZEX '83 pilot program that inapperl ire invenient and studied ire pack behavior in the Bering Sea (Ees, October 4, 1983, p. 578, and December 21, 1982, p. 1220).

Seven ships and eight aircraft are participating in the MIZEX experiment, which is designed to report during the months of time and July on the dynamic interaction of the lie with the ocean and atmosphere. "There has not been, at one time, such a complete multidisciplinarry project," according to Ken Davidson of the U.S. Naval Postgradnate School, who is chairman of the experiment's meteorological companent.

Each season the edge of the polar ice field in the Arctic Sea moves northward or southward as much as 600 km. These shifts in pasition and energy balance in turn affect weather patterns for the entire northern hemisphere. The MIZEX experiment uses in situ measurements by ships moored in the ice pack as well as remote sensing from aircraft. to obtain a thorough study of the dynamic interactions. One ship is moored to tho ice 30-50 km inside the edge of the ice field, while

Telephone (503) 754-2296

the others are arrayed around that central print within a "box" approximately 200 km square, At the location of the box shifts around with the movements of the ice pack, the ships munitor conditions of the upper ocean, the atmospheric boundary layer, and

majim while reconaissance aircraft are mapping the entire narving box with synthetic apriure radar, microwave cameras, and "We want to study the melting and movement of the ice-the evolution and changing of the ive edge," says Davidson, "The atumadiere and ocean control these changes, and

lee characteristics, where appropriate. An ar-

ray of transpontlers relays data no ice delor-

# Waterman Award

the processes are simply not well under-

Numitations are now being accepted for the Alan T. Waterman Award, which annually recognizes an outstanding young scientist in the lorefront of science. The award, named for the first director of the National Science Foundation [NSF], was established by Congress in 1975 to mark the agency's silver

Candidates for the 1985 award must be U.S. chizens and must be 35 years old or younger for that be more than 5 years beyond receipt of the Ph.D. degree by December 31, 1984). Candidates should have completed sufficient scientific or engineering research to have demonstrated through personal accont-plishments outstanding capability and excep-tional promise for significant future achieve-ment, the award committee says. In addition, those nominated should exhibit quality, innovation, and potential for discovery in their re-

la addition to a medal and other recognition, the recipient will receive a grant of up to \$50,000 per year for up to 3 years for scientific research or advanced study in the physical, biological, mathematical, medical, neening, social, or other sciences at the institution of the recipient's rhoice.

Six copies of each nomination should be submitted to the Alan T. Waterman Award Committee, National Science Foundation. Washington, DC 20550. Additional information and nomination forms may be obtained from Lois J. Hamaty, executive secretary for the award committee [telephone: 202-357-7512). The award is annunced every May. For candidates in be considered for the 1985 award, unminations must be received by De-

## Acid Rain Report **Focuses on Forests**

Recent research on acid precipitation yields "increasing general concern about possible effects in forests," according to the second annual report of the National Arid Precipitation Assessment Program (NAPAP). Prepared by the Interagency Task Force in Acid Precipitation, the report outlines the accountillshnuents of the national program during fiscal 1983, sommarizes the corrent state of scientific knowledge (including a rhange in the baseline acidity of precipitation), and describes the notlook for current progress by federally funded acid precipitation research. Chris Bernabo is the program's executive dl-

NAPAP's annual report agrees with the finding of a National Research Council (NRC) committee that a linear relationship exists between sulfur dioxide emissions and wel deposition of sulfate (Eas, July 26, 1983, p. 475). NRC's Committee on Atmospheric

Transport and Chemical Transformation in Acid Precipitation, which issued its report last year, was chaired by Jack G. Calvert of the National Center for Annuspheric Research.

While not blaming acid deposition for the "environmental stress" on North American and European foresis, the report states that "evidence analyzed during the past 3 years indirates that significant changes in growth and vitality of some species have occurred in the eastern U.S. forests." The report artris, "It appears that forests in the United States may be responding to strestes that have been occorring for the past 2-3 decades."

The report also notes that the baseline acidity of precipitation needs to be changed from a pH of 5.6 to 5.0. "Early estimates of the natural pH of preripitation were hased solely on the equilibrium of rathon dioxide in the atmosphere with 'pure' water," the report explains. "A pH of 5.6 was subsequently cluisen as the baseline against which the seriousness of current acid precipitation levels was judged. It is now clear that other natural lactors, such as organic acids, naturally entitted sulfur and nitrogen compounds, and alkaline dust, also affect precipitation's normal acidity. Any baseline pH must account for these factors and the 5.6 value is no longer appropriare." Using the pH 5.6 baseline, scientists hard concluded that the eastern United States reecived precipitation 25 times more acidic than expected in natural precipitation. Using the new baseline nl' 5.0, however, regions in the United States with the most acidir annual average precipitation are "catimated to receive

ti-7 times the average background natural acidity of remote array." The national program is divided into 10

task groups: natural sources, non-made sources, amaispheric processes, deposition monitoring, aquatic effects, terrestrial effects efferts on materials and column resources, control technologies (funded nisler other preexisting programs), assessments, and international activities. Progress of research during liscal 1983 and a research nutlook are detailed for each.

The jongram's overall task force is chaired jointly by the National Oceanic and Atmospheric Arlministration (NOAA), the Environmental Protection Agency (EPA), and the U.S. Department of Agricolture (USDA). Other jointicipating federal agencies are the Department of the Interior, the Department nt Health and Human Services, the Department of Connaerce, the Department of Energy, the Department of State, the National Aermantics and Space Administration, the Council rot Erevironmental Quality, die National Science Franclation, and the Tennessee Valley Authority. The task force also includes four presidential appointees and the directors of the Department of Energy's Argonoc, Brookhaven, Oak Ririge, and Pacific North west national laboratories.

Capies of the National Acid Precipitation Assessment Peogram's 1983 annual report to the president and Congress may be obtained by writing to the NAPAP Executive Director. clo EOP Puldications (Ronn 2200), 726 Jackson Place, N.W., Washington, DC 20503

# Classified

RATES PER LINE

al inscributs \$1.50

Positions Available, Services, Supplies, Courses, and Announcements: http://inscribin.Sh.lkt.additional insertious \$4.23. Positions Wanted: trest Inscribert \$2.00, addition

Student Opportunities: has posertion free, addi-Bonal meertions \$2.00.

There are no discounts or commissions on classified ads. Any type style that is not publishor't choire is charged at general advertising rates. For is probledized wrekly on Tuesday. Ads-must be received in writing by Monday. I wrek pnor neithe date of publication.

Replies to advivide buy tamplets should be addressed to Box .... American Genderstal Union, 2000 Florida Avenue, N.W., Washington, DC 20069

For more information, call 202-462-6903 or toll free 800-424-2488.

POSITIONS AVAILABLE

Physical Oceanogrephers. The Marine Libe Research Group of the Scripps Institution of Oceanographs unlies physical occurring applies to apply for a research position. The research contradent of the professional series (Ph.D or equivalent required), to study the circulation of the California run ent and existence with the circulation of the California run each position with the circulation of the California run each position with the circulation of the California run each position with the circulation of the California run each position with the circulation of the California run each position with the circulation of the California run each position with the circulation of the California run each position with the circulation of the California run each position with the circulation of the California run each position of the California run each position. easiern north pacific, support is offered for two yeers. After which the candidate may be expected to

yeers. After which the candidate may be expected in generate all or part of continuing support. Salary range \$25,100—16,900. Level of appointment to be based on qualifications. Position start date from 1 September 1984. Please scalar returns and at least three references to Director, Marine Life Research Group, A-430, Stripps Institution of Oceanography, 1 a Julia, Cali-fonia 92093 by August 1, 1984. The University of California, San Diego is an equal oppon unity/affirmative action employer

Postdoctorsi Postilen/University of Arizona. rosioctoral Position University of Arizona. A posidoctoral position has been opened at the Lunar and Planeary Laboratory. University of Arizona, Tucson, Arizona, in July 1984. The research is in the general area of space and planetary physics with much of the work related to Voyager EUV observations at the government. much of the work related to Voyager ÉUV idiservations at the outer planet encounters. The program
includes work in plasma physics roncerned meatly
with the fundamental nature of the lo plasma povus,
upper atmospheric and autorial processes on Jupiter, Saluria, Titan, Uranus and Neptune, exospheremagnetosphere modelling at Saturn, and some sperialized aspects of the interstellar-interplanetary medium. The applicant should have a background in
atonic and molecular physics with an interest in
planetary aum spheres. Applications should contain
vita, statement of interests, and names of three references, and should be submitted by Angria. 20,
1934. Further information can be obtained by rontacting D. E. Shenmanky, Lumar and Planetary Laborators, 3025 E. Aio Way, Turanu, Arizona 88715. oranory, 3025 E. Ajo Way, Tucson, Arizona 85715; The University of Arizona is an equal apportuni-

Ocean Engineering Research/University of California, San Diego. The Institute of Merine Resources at the Scripps Institution of Oceanography, University of Californie, San Diego has three openings for assistant/associate research engineers or assistant/associate research programs. Candidates should heve a Ph.D. or equivolent in engineering, physics or oceanography, e publication rerord and Should have interest in teking part in research in one or more of the following fields: 1) deep oceon waves, remote and in aitu measurement and analyses of directional spectra, and wave/strurture interactions, 2) floating and fixed platforms, response to waves, strurtural analysis, corrosion end fatigue, 3) ocean floor geotechnical studies, inhiadon of mass movements, soour and soft bottom enrhots. The salary range is \$25,100-\$35,300, depending upon qualifirations. Appointment duration two years with possibility of indefinite oxension. Appointment at the associate level requires a record of successful funded sesearch. Associate professor sank requires leaching experience. Send resume and names of references before 1 September, 1984 to: F. N. Spiess, Director, Institute of Marine, Resources, or R. J. Seynour, Head Ocean Engineering Research. Croup, Institute of Marine, Resources, or R. J. Seynour, Head Ocean Engineering Research. An equal opportunity, affirmative action omployer.

Project Associate/Specialiat: Electron Micro-Probe Lab, University of Wisconsin-Madison. Strong analytical background in quantitative EMP analysis and familiarity with companies is required. The Lib has a 9-spectrometer ARL SEMQ and a JEOUGO 30-A SEM, Drugs will include instrument maintenance, inspractioned stodents, the elopatem of procedures and analysis. Research will be encouraged. A MS or Phil is required in Earth Science, Chemsity, Physics or Engineering, Minimum galaxy will be \$18,000/12 months with not MS. Send letter of application, trains, opts, cestime, and natives and address. \$18,000 (2 months with 50 MS, Senti lever of appro-cation, transcripts, costinue, and names and addres-es of three references by September 15 to Dr. John W. Valley, Department of Geology & Geophysics Weeks Hall, University of Wisconsin, Madison, WI \$2700.

An equal opportunity ymplover

Science Writer. AGU is expanding the For soft and has an immediate opening for an expenenced reporter/writer. Cambidate must be able to research. mergret, and write on new stemple research. reads, and/or coults for readers. Will also prepare trends, and/or cosmis for readers. With an isopartion in the science community and the general public, in addition, candidate will be expected to particular in AGUs developing juddic information actions. Salary \$19.000—\$25.000. Send resume with news writing samples to. Personnel Office

American Geoglicical Union 2000 Honda Avrine, N.W. Washington, D.C. 2000.

Resecrets Associate/Research Technirlan. The University of Maine at Oream (CMCI) has an openlog for a research associate/research technican ab would work in a small geophysical group. We seek ao individual who can use and maintain maders would work in a small geophysical group, the analysic and individual who cart use and maintain modera digital electronic equipment; for example, maticiannel analysers. 101 interfaces for microcomputers, digital plotters and digitaling tablets. Familiant with BASIC and FURTRAN will be needed, and some geophysical field work may be required as part of the obttles of the appointee. Current handing permits an appointment for at least 12 months stduct to arrival of anticipated funding, the appointment period could be extended to two years or longer. Call Edward R. Derker at 207-581-2132 nr 207-581-2132 about the position. Otherwise, and inquiries, a vita and at list of at least three references to Edward R. Decker, Department of Geological Sciences, 110 Boardman Hall, University of Mainr st Orono, Orono, ME 044tist.

The University of Maine is an equal opportunity effirmative artion employer.

Electrical Engineera/Computer Professionals/Systems & Analysia/Physiciata/Mathemotelans. Systems & Analysia/Physiciata/Mathemotelans. Systems & Analysical Sciences, Inc., a young alysamic company, invites applicationa from BS/MSPhD degree holders to full many positions. Experience in Signal Processing, hardwaredsoftware development. Communication Systems R&D, Systems Analys. Numerical and Simulation studies, Remote Senting, Meteorology, Space Sciences and related fields. U.S. Meteorology, Space Sciences and related fields. Laciatenship required but not a must. Excellent alactic and impartalled company paid benefits officed fields end resume to: Mr. Chailes Gillix, Oriector of Marketing, Systems & Analytical Sciences Int. Hanscont Civil Air Terminal Quilding, Bedford, MA 01731.

effirmative artion employer.

Postdoctosel Research Assorlate Positions/Geophysics and Igneous Geochemistry. The University of Maine at Orome (UMO) has postdoctoral openings for a solid earth geophysisial and an igneous geochemist. We seek a geophysirit who sinks to advance fundamental innderstanding of past and to advance fundamental innderstanding of past and to advance fundamental innderstanding of past and corrent thermal histories of the Appalachian Orogen in New England and elsewhere. The geochemist would be experted to acceptate whank and plutonic suites in the Appalachians in Maine and plutonic suites in the Appalachians in Maine and in other terranes. Current lunding permit appointments for at least 12 months, Subject to atrial pointments for at least 12 months, Subject to atrial pointments for at least 12 months, Subject to atrial pointments for at least 12 months, Subject to atrial pointments for a least 12 months, Subject to atrial pointments for geothermal research, computer applications for geothermal research, computer applications, for geothermal research, computer applications, at UMO. Additionally, limited funds are available and research and geochronologis studies season longities, a vita, a list of referees, and Please seem! Inquiries, a vita, a list of referees, and Please seem! Inquiries, a vita, a list of referees, and Please seem! Inquiries, a vita, a list of referees, and Please seem! Inquiries, a vita, a list of referees, and Please seem! Inquiries, a vita, a list of referees, and Please seem! Inquiries, a vita, a list of referees, and Please seem! Inquiries, a vita, a list of referees, and Please seem! Inquiries, a vita, a list of referees, and Please seem! Inquiries, a vita, a list of referees, and Please seem! Inquiries, a vita, a list of referees, and Please seem! Inquiries, a vita, a list of referees, and Please seem! Inquiries, a vita, a list of referees, and Please seem! Inquiries, a vita, a list of referees, and Please seem! Inquiries a vita a list of referees, and Please seem! Inquiries a vita a list of re

or Lox.; The University of Maine is an equal opportunity

University of Texas at Austin. The Department of Geological Sciences invites applications for a person to teach depositional systems and periodentic geology at the unitergraduate and graduate levels and periodent a constitution. to conduct a vigorous research program, including die upervision of graduate students, in the area of the person's interest. The person must be offling to each the above subjects to mon-majors on occasion. The position reguires the Ph.D. and is open to both Applied Organic Chemiat/Geochemist. A leader is sought for a six-person group involved with federally limited research on the sampling, rhararterization, and fate of anthropogenic organic rhemicals in the environment. The surressful applicant will have had a minimum of seven years post-Ph.D. research experience, at least three years of which will lave been as principal investigator/project manager, including such artivities as selecting, diretting, deteloping, motivating and evaluating professional staff members, and interacting with potential or existing sponsor reper esematives. Demonstrated rapability to initiate and conduct original, high-quality research is essential. Strong written and aral English language skills and the ability to communicate effectively with individuals in other disriplines are required. A strong record of technical publications and surressful program development is essential. Applicants with interest in groundwater systems or atmospheric rontaminants will be given special rensideration, but those with other interests in environmental organic chemistry/georhemistry should not hesitate to submit their credentials.

The individual selected for this position will be responsible for a state-of-the-art arganic analytical tenure-seeking jumot persons and senior-level per-sons. Availability by January 1985 is desirable. Ap-plicants should submit a detailed resource, names and addresses of live relevences, and a statement of and addresses of the reflectives, and a statement of tearling and research interests by November 1, 1984 to Dr. Earle F. McBride, Department of Gen-logical Sciences, University of Texas, Austin, Texas 78712, New Ph.D.-Imblers should also solunical ropy of their dissertation abstract.

The University is an equal opportunity/affirma-

Geophysical Fluid Dynamielo. A Princeton-based research corporation has a challenging position open for an individual with Ph.D. level experience in Numerical Modeling of Geophysical Fluid Dynamics. The successful candidate with have demonstrated expertise in one of the following areas: Modeling of Current, Wave and Sediment Transport in Entrarine, Coasial and Shelf Waters; Development and Application of Three-Dimensional Numerical Models of Oceanic or Atmospheric Phenomena of Meso- or Smaller Scale; Modeling of Turbulent Transport. We offer a creative work environment, excellent health package, and salary commensurate with experience. Send resume and names of three references by August 15, 1984, in complete confidence to: Alexandria Lover, Personnel Administrator, Aeromautical Research Associates of Princeton, Iur., P. O. Box 2229, Princeton, NJ 08540.

An equal opportunity/affirmative artion employer

The University of Adelaide, South Australia. Invites applications from built men end women for the following positions: IECTURERS IN PHYSICS

TECTURERS IN PHYSICS
(Tenniable—Two Positions)

[Ref A1781, A1709), Applicants should have a commitment to excellence in tearning and research, and experimental or theoretical experiment receivant to one of the research fields of the Department.

Duties will include undergraduate teaching, postgraduate supervision and research.

The major research interests of the Department include: Atmospheric Physics, Alonic and Molerniar Physics, Condensed Matter Physics, Losnic Radjation finduding high energy gammu-ray astronomy, Physical Archaemetry, Seismology, and Theoretical Nuclear and Particle Physics.

These positions are available from 11 February 1985.

Detailed information about the Department can be obtained from the Chairman, Dr. WG Elland (08) 228-5321. An academic review of the Depart-

Holders of full-time remitted or remitable academir appointments have the opportunity to take leave without pay on a half-time least for a specific

kare without pay on a hall-time least for a specific period of up to ten years where this is necessary by the care of children.

It is University policy to encourage women to apply for consideration for appointment to, in particular, remarable academic positions.

FURTHER INFORMATION about the general conditions of all appointments may be obtained from the Senior Assistant Registrat (Personnel) in the University. SALARIES per angum \$A24,353 x 7-\$A31,994

Subject to review).

APPLICATIONS, IN DUPLICATE, quoting reference numbers and giving full personal particulars finduding residential status), details of analemir

Paculty Positions in Geophysical Sciences/The University of Chicago. The Lepartment of the Geophysical Southers mysical states are applications for positions at all lerels across the entire range of earth and planetary sciencet, jachiding introvology and

The Werkly Newspaper of Geophysics

For speediest treament of contributions send three ropies of the double-spaced monuscript to one of the editors to and below and one ropy to

Editor-in-Chiefi A. F. Spilhaus, Jr.; Editorat Marrel Ackerman, Mary P. Aoderson, David A. Bruoks, Brure Doc, C. Stewart Gillmor (History), Clyde C. Coarl, Louis J. Lauzerottl, Robert A. Phinney; Managing Editor: Mirhael Schwarts; News Writer: Barkara T. Richman; News Assistant: Tony Reirkhurdt; Production Suffi Dae Sung Kim, Patricia Lirliicilo, Lisa Lichtenstein, Cynthia T. McManigal, Kathryn

Officers of the Union Charles L. Drake, President; Peter S. Eagleson President-Elert; Peter M. Bell, Generel Secretary; Juan G. Roederer, Foreign Serrerary; James A. Van Allen, Part President; A. F. Spil-haus, Jr., Exernitve Dirertor; Waldo E. Smith, Executive Director Emeritos.

For advertising information, routert Robin E. Lutte, advertising coordinator, at 202-162-6903 or tall frea of 800-424-2488. Advertising must be information and advertising must be information. tive and consistent with the scientific and educe tional goals of ACU and is subject to approval by ACU. Advertisers end their agents assume li-

Cover. This shear zone in quartz diorite represents an early stage in the formation of fault googe. The sample originated 518 m below the sorface in Stone Canyon, San Benlto County, California, and was collected while drilling a well 1.2 km from the creeping segment of the cen-tral San Andreas fault in 1972. Alteration has softened plagioclase grains, while quartz grains appear brittle. Preliminary analysis suggests that the dark bands separating the shear zone from the relatively undeformed rock are comprised of chlorite and mixed-layer illite-montmorillonite. The shear zone is about 30 mm wide at the center of the figure. (Photo sobmitted by Don Stlermen and Al Williams, Institute of Geophysics and Planetary Phys-ics, The University of California, River-side California, River-

ability for all content of their advertisements and for any claims arising therefrom against the publisher. Offers la advertisements are subject o all laws and are void where prohibited.

Copyright 1984 by the American Geophysical Union. Material in this issue may be photoropied by individual scientists for research or classrnom use. Permission à also granteil to use short quotes and lightes and tables for publice-tion in scientifir books and journals. For permis sion for any other uses, romaci the AGU Publi-

Views expressed in this publication do not necessarily reflect official positions of the American Geophysical Union unless expressly stated.

Subscription price to members is included in annual dues [\$20 per year]. Information on insti-tutional subscriptimus is evailable on request. Second-rlass postage paid at Washington, D. C., and at additional mading offices. Eas, Transac-tions, American Geophysical Union [ISSN 0096— 2011. is published people.

> American Ceophysical Union 2000 Florida Avenue, N.W. Washington, DC 20009

> > An Ipvitation

Would you like to be on the cover of Eas? If you have any illustrations with both aesthetic charm and scientific interpotn assumetic charm and scientific interest—photographs (preferably black and white) of geophysical phenomena, experimental results, or graphs—Eas would like to consider them for publication on the cover. Send the original illustration or 8 x 10 incl. (20 x 25 cm) glossy photo with a short (50–200 words) avalanation that can short (50-200 words) explanation that can servo as a caption. You may also submit a more extensive news Item or even a short article to accompany a proposed cover;
Captions will be by-lined. If the material has been previously poblished, please supply a copyright release from the copyright owner. Send it to Eas Cover, ACU, 2000 Florida Avenue, N.W., Washington, DC 20009.

8000 PUBLICATIONS

qualitications and names and addresses of three ref-ercer should reach the Senior Assuman Registrar (Personnel) at the University of Adelaide, GPO Box 498, Adelaide, South Australia, S001, Telex UNIVAD AA 89141 nm later than 30 September 1084

The University reserves the right not to make an oppointment or to appoint by invitation.

responsible for a state-of-the-art organic analytical laboratory lorated in a major Midwestern research facility, with acress to a wide range of supponing rhemical-analytical and computer facilities in the narent organization

parent organization.

Detailed professimal histories should be sent to:
Oux 027, American Geophysical Union, 2000 Florida Avenue, N.W., Washington, D.C. 20099.

An afternative artion/equal opportunity employ-

Renualizer Polytechnic Insidute, School of Sel-once/Deao. Renuselaer is a private, coedinational, non-denominational technological university hormed of Schools of Architecture, Engineering, Human-ides and Surial Sciences, Management and Science. The School of Science contains Departments of Bi-ology, Chemistry, Geology, Mathematical Sciences/ Computer Science and Physics and offers B.S., M.S. and Ph.D. degrees in these fields as well as in inter-distribitory areas.

istiplinary areas. The Institute has mounted a major program of rowth of the School of Stiente. In common with he Institute as a whole, the School of Sciente look

lorward to continued expansion of graduate and re-search activity. Dean of Science candidates are ex-

searth activity. Dean of Science candidates are ex-pected to have a strong background in one or more of the relevant sciences and to have demonstrated a commitment to excellence in both education and re-search. Pertinent administrative experience is a strong positive factor. Paramount one the qualities of vision, judgment and leadership to match the op-portunity offered by the projector growth of the School of Science.

portunity interest by the projector of Science.

The position will be open in early 1985, Beadline for applications is August 20, 1984, Please send nominations and applications to:

Professor Ularles P. Bean, Chantman

Dean of Science Search Commune Science Center Reusselber Polytechna, Institute Troy, NY 12180

Reusselaer is an affirmative action/equal opportu-

American Water Resources Association 5410 Grosvannr Lane, Solte 203 Bethesda, Masyland 20814

The Potential for Water Yield Augmentation Through Forest and Range Management

Edited by STANLEY L. PONCE

Reprinted from the June 1983 Water Resources Butlefin

19B3 \*6B pages \*7 papers \*coft cover

This publication is the most definitive collection currently available on the potential for augmenting water supply through torest and rangeland management. It draws logical industrial reviews by experis from the torested lands of the East, West, and Northwest to the rangelands of the Southwest, who explore the opportunities for increasing water supplies to their regions within the frameword of railonal had management, A paper explosing the accommit questions insolved in point water and tumber production, and an exploration for the follows. and an exploration of potentials and problems for the futu-tound out a volume which promises to but a major soferer in the field to: some lims to come.

Copies at \$7,50/each Copies at \$5,95/each (plus \$1.00/each for postage & handling)

SATELLITE HYDROLOGY

Edited by M. OEUTSCH, O. R. WIESNET,

ACID RAIN

A Water Resources Issue for the 80's

Edited by

RAYMOND HERRMANN

A. IVAN JOHNSON

Reprinted From
Proceedings of the international
Symposium on Hydrometeorology

1B88 \* 11 papers \* 84 pages \* aoft cover

National recognition of the "acid rain"

seue has psecipitated numerous effort

to address the many related questions

These 11 papers, taken togethes, act the

stage of ongoing U.S. activities within an arens of interdisciplinary relationships

and also put in perspective the signifi

renes of the said deposition problem as

national water, and related riparian.

ond A. RANGD Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sansing

1B81 \* 730 pp. \* 100 papers \* bardbou \* 101 full color illustrations\*

This Symposium was organized and rigid-ly structused for the primary objective of producing a compassionaive and believed sourcebook on applications of apace lech-nology to hydrolegy and all of its mole-subdisciplines, and to man's impact upon subdisciplines, and to man's impact upois the hydrologic cycle, The volume includes chepters on selellite deta applied to:

- Meteorology To Snow and toe to Surface Wotes
- Solt Molature
  Water Quality & Environment Ground Wates Wetlands
- Ceestal Zono Hydro Octo Rolay
- Water Uso & Managemon

Coples at \$85.00/each (plus \$6,06/eack fee pestage & hondling)

(plus \$1.00/cach for postage & bandling)
(bulk order lufo, available upon sequest) Proceedings of the INTERNATIONAL SYMPOSIUM

ON HYDROMETEOROLOGY Edited by A. IVAN JOHNSON ROBERT A. CLARK

1983 \*508 pp. \*93 papars \*hardbound The 98 papers in this Proceedings volume provide background material for thom any applications of hydromoteorology by hoth metaorologists and ongineers. They illustrate the diverse luterests of the several pacticipating societies and of the numerous selentists from the Federal. state, university, and privote sectors. This volume la organized toto eight accilono that does with the following various program arens related to hydron natrumentation & Onta Acquisition, Hvdrologie Modeling and Forecasting, Water Supply and Water Resources, Long-Tern Planning for Water Quality, Osought and Cilmato, Weathar Modificetion, Acid Rain, old Prohable Mozimum Precipite tion sod Frequency for Dosign.

Copies at \$-10,00/each plus \$6.00/each for postage & bendling)

PAYMENT MUST ACCOMPANY ORDER AND MUST BE MADE IN U.S. DOLLARS DRAWN ON A U.S. BANK, - Bulk order prices upon raquest, / No discount to book dealers, - Orders within the Continental U.S. may be shipped via UPS and cannot be delivered to P.O. boxes.

TDTAL AMT, ENCLOSED [Maryland residents add 5% sales tax]

occanography. Partirular attention will be given to applications in interdisciplinary attent with prospects of major advances in observation, theory and appliof major assistes in operation, mony and apparation. Please send resource and reprint to Joseph V. Smith, Charman, Appointment Commutee, 5734 South Elia Avenne, Universe, Illinois 10037, USA. Application will be considered rapidly throughout the year.

The University of Chicago is an equal appartunity action charles.

Bedford and Royal Colleges/Lecturerehlp in Geology. Applications are invited for a new lecture-Bedford and Royal Colleges/Lecturerein in Geology. Application tare invited for a new lectureship in the department being rreated by the analgamtion of the geology departments of Bedford, Chelsea and King's Colleges. The held of specialization and level of appointment is open but a very strong interest and/or ronsiderable experience of radiogenic isotope geology is essential. Gross salary range lunder review) £8,376—£15,311 p.a. Further particulars and application form (returnable by 14 September) may be obtained by sending s.a.e. to Personnel Serretary, Bedford College, Regent's Park, London NW1 4NS, England.

Postdectoral Fellowahip/Geophysical Insultote, University of Alaska, Fairbanks. Ph.D. in Physics with extensive rourse work in all creas of Physics. Preference will be given to candidates with some experimental work in infra-red spectroscopy, 2) digital electronics, and 31 numerical modeling. Work will involve field observations of airglow and euroral emission analysis end some reaching. Salary at least \$34,800/year D.D.E. One year appointment with renewal of up to two more years. Write to: Dr. Abas Sivjee, Geophysical Institute, C.T. Elvey Buikling, University of Alaska, Fairbanks, AK 99701. Deadline for epplications: 8–31–84.

University of Alaska is an equal opportunity/affirmative action employer. Your application for em-

mative action employer. Your application for em-ployment with the University of Alaska may be sub-ject to public disclusure if you are selected as a final-

Scripps institution of Oceanography, Geological Research Divisions Postdoctorel Research Stable Isotopes/Sedimentology. Applications are invited for a postdoctoral position in the Ceological Research Division of StO. We ose looking for candidates with a strong hackground in chesnutry, and an interest in paleoceanography, paleoclimatology, or carbonate geochemistry and sedimentology. Preference will be given to persons experienced in the operation and maintenance of mass spectrometers. Level of oppointment and salary will be commensurate with experience, according to University of Californie standards. Applications and rorriculum vitae (2 copies), and references, should be addressed to Drs. W.H. Berger or M. Kastner, Scrippa Institution of Oceanography, La Julia, CA 92093, A-015, before August 15, 1984.

Geophysicist. Challenging position in Scoul, Korea requires degree in geophysics and three years related work experience or ten years experience in geophysics methods with four years interpreting held data from Instrumentation. Modern computee competency required: Excellent salary, cost of living differential, and comprehensive benefits. For interview call Ron Baptie at 703-960-8SOS or send resume to: VSE Corporation, 2SSO Homington Avenue, Alexandria, VA 22303.

An EOE M/F/V/H.

POSITIONS WANTED

Exploration Geologist. Specializing in resource exploration and development tunneral, petroleum, and groundwater-also inining and petroleum engineering Johns Hopkins PhD with extensive practical experience in the Middle East and elsewhere. Mpkibngual diocut in Persian and Turkish). Reply to Box #25, American Geophysical Union, 2000 Florida Avenue, N.W., Washington, D.E. 2009.

SERVICES, SUPPLIES, COURSES, AND ANNOUNCEMENTS

Thermosphere Dynamics 11. October 3-5, 1984 Goddard Workshop on Thermosphere Dynamics 11. Ramada Inn, Calverton, MD. Cheirman, Hous G. Mayr, Goddard Space Flight Center /Aleta E. Johnson, Laboratory for Atmospheres, NASA/Goddard Space Flight Center, Greenbelt, MD 20771). This meeting will assess our rurrent understanding of thermosphere dynamics and identify new directions for scientific research in thet specialty. Data secently obtained from the Dynamics Exploree apparent system and new measurements from secently obtained from the Dynamics Exploree aparecraft system and new measurements from ground-based facilities allow on to quenotatively address questions regarding thermosphere-tonosphere-magnetosphere coupling processes. The emphasis of the weekshop will be on describing the structure (temperature, composition) and dynomics of the neutral thermosphere. Some topics that will be discussed are: Thermospheric Energization Processes, Long Term Variations and Superrotation, Gravity Waves, Mesosphere-Thermosphere Coupling, and Plenetary Thermospheses. Titlen for contributed papers should be submitted by July 31, 1984.

NATO Advanced Study Institu

Traneport Processes in Oceans and Almosphere.
Les Houches, French Aljia, February 11–22, 1985.
A prinary ulsjeetive of the course is in develop understanding of the lasge scale asmospheric dynamics, ocean dynamics and the interactions between ocean and atmosphere. The principal lecturers (Blackman, Cill, Hoskina, Rhines, Welandee) will state the bounce is the state of the principal decipied. ers (Blackman, Gill, Hoskina, Rhines, Welandee) will covee the above topies, starting at a selatively simple level and developing them to ailvanced research level. In addition, a number of more spelcalized lectures will be given by supporting lecturers. The institute is intended for graduate stodents or young postdoctoral researchers. Limited funding is evailable. Scudents should write to Dr. J. Willebrand, Institute for Meereskunde, Dusternbrooker Weg 20, D-2300 Kiel 1, W. Geemany, for further information, as soon as possible.

AGU **MEMBERS** 

Tell your friends, colleagues, and students about AGU. Call 800-424-2488 for membership applications.

451

# 1984 James B. Macelwane Awards



Mary K. Hudson

### Citation

1000

Mary Hudson is being honored as one of the 1984 James B. Macelwage award winners hecause her theoretical research in the microphysics of magnetospheric plasmas has been at the forefront of the field, has inspired many experimental and theoretical studies, and has stimulated her colleagues and students.

from her earliest work as a graduate student, Mary has displayed a pronounced talent for recognizing a challenging problem, understanding the experimental data, formulating a theoretical approach, theoretically interprering the data, and working with experimemalists on the consequences of ber theory. Her Ph.D. research, on the equatonal Rayleigh-Taylor instability, called Equatorial Spread F, was undertaken on her own britiative and printneed a sophisticated collisional, linear instability analysis which showed that drift waves play an important role in this phenomenon. Her collaborations with expenmentalists verified this result and led to an analytic nonlinear solution for the evolution of two-dimensional plasma bubbles that are now known to occur in Equatorial Spread F.

After completing her Ph.D. thesis at the University of California, Los Angeles, in 1974. Mary joined the research staff at the Space Sciences Laboratory of the University of California, where data from the \$3-3 satellite were being analyzed to characterize the auroral particle acceleration region. In this region, which exists at an althode of about 6000 km above the auroral innusphere, electrons are accelerated by plasma processes to kilovolt energies, after which they implage on the upper atmosphere to produce the bril-liant luminosity that we know as the aurora. In spite of intensive research on the physics of the autora and of magnetospheric particle acceleration for several decades, it was not until the observation and interpretation of upward accelerated ion beams and conical distributions, coherent ion cyclotron wave

# **NOMINATIONS** FOR AGU FELLOWS AND AWARDS

September 15 is the daadline lor nominations from the memberahip los AGU Fellows, Special nomination iomis ere sveilable for your use in nominaling a insind or colleague ee a

November 1 is the doadine for nominations lot awards for 1985. Nominations are bolng accepted for the William Bowie, Wnldo E. Smith, John Adam Fishting, Weltar H. Bucher and Maurico Ewing Medals and the James B. Mscolwane Awards. Letters ol nomination outlining significant contributions and curriculum vitae may be eent directly to AGU for forwarding to the appropriate selection

For Fellows nomination lorms, information on criteria for the ewerds, or a list of past recipionis call or write:

> Member Programe American Geophysical Union

2000 Florida Avenus, N.W. feshington, D.C. 20009 (Telephone: 462-6903 or toll (cae: 800/424-2458 utside the Washington D.C. area)

emissions, electrostatic shocks, and double layers, that the fundamental plasma physics of the aurora began in unfold, Here, again, Mary Hudson's ability to relate observations to theory played a key role in developing this understanding. She, and her research group, performed analytical calculations where need ed and established a whole new effort in compoter simulation in order to compare observed electric field structures with plasma theory. As a result of this work, a considerable body of knowledge was obtained on the fundamental mechanisms of auroral particle acceleration and the microphysics of large-

scale plasma interactions. While achieving this outstanding research record, Mary Hudson has also taken time to teach both at Berkeley and at a local women's college, and to direct the thesis research of several outstanding students. Thus, she has served as a role modd for both young women and young men embarking on scientific careers.

Her many colleagues and friends congratulate Mary Hudson on receiving this award and wish her well in her future research ca-

> Michael C. Kelley Forrest S. Mozer George K. Parks

### Acceptance

Thank you Mr. President, Mike, and AGU members. It is an honor to receive this citation from a past Macelwane award recipient. would also like to thank Forrest Mozer, who abored over the choice of words for the chation, George Parks for initiating the Macelwane award effort, and Charlie Kennel for his contribution to the citation. All of these people bave contributed to my career, about which I will have more to say.

I would first like to thank my family. My father asked me when I was 7 or 8 years old why I was copying the periodic table of elements onto a shopping bag. I told him "I was dning physics," and he replied, "That's not physics, that's chemistry." I thank my family for such insight and the freedom to explore and discover, even when it meant putting up willt an amateur astronomer's hours.

Skipping ahead over my undergraduate days at UCLA, my first real job in the scientific community was with the Space Physics Laboratory at the Aerospace Corporation. After a hrief attempt to make an experimenalist out of me, I was given the opportunity by George Panlikas and colleagues to work pretty independently, attend scientific meetings, and generally getting a feeling for re-search in our field. The eucouragement I received and interests I developed while at Aerospace prompted me to seek out Charlie Kennel when I returned to UCLA for gradu-

Charlie was a great person to work for. He devoted a lot of time to my research problem, and I greatly appreciate the guidance and encouragement he gave me. I was working on equatorial spread F at the time, and Charbe suggested that I look at some data, so I contacted Ben Balsley of the National Oceanic and Atmospheric Administration (NOAA) and Mike Kelley at Berkeley, who were involved in a radar and rocket campaign scheduled for summer, 1973. I convinced Charlie that I really ought to go on this experimental junket which was an integral part of my thesis. What I hadn't learned about during my time at Aerospace, because it was a period with few launches, was experimental delays. I planned an elaborate route to Natal. Brazil. or the rocket launches, and called Berkeley the day before my planned departure to find out how people could reach me there. Fortest aformed me that the campaign had been delayed for several months and that Mike Kel-

ley was no vacation in Cozumel. At that point Forrest realized that he was dealing with a real theorist, but he gave me the job at Berkeley anyway. I never did make it to Brazil, but Forrest compensated by sending me to Thompson, Manitoba, the next year to launch balloons. Mike was there, along with George Parks. That was about my last adventure in experimental physics. I have, however, maintained my keen interest in the exciting data that has poured out of the Berkeley group and magnetospheric physics in general

I got interested in another kind of experiment in the meantime, that is done on computers. Ned Birdsall was teaching his course in plasma simulations at Berkeley, so Doug Potter enrolled to get a user number and I sat in on the course with him. Since then, my collaboration with the Birdsall group has been a mainstay of my research. I brought in Han Roth, as a post doc, who had been a student of Cuperman's at Tel Aviv, to work with me full time on the simulations. Ilan has been a wonderful person to work with, and has liung in there through the ups and downs of funding and threats of imminent departure,

over the lust 10 years.

I started recruiting another Kennel graduatc student, Bill Lotko, about 4 years ago. By the time Bill arrived, he had already written a proposal to the National Science Foundation (NSF) to fund his research at Berkeley, and

it's been pretty hard to tell him what to do ever since. I thank Bill for his significant contribution to my research efforts and fur putthing up with my bigh entropy state. I thank the rest of the research staff at

Berkeley, Kinsey Anderson, and Forrest, who have done a lot more than send me on balloon campaigns to further my career, and the past and present graduate students. I particularly want to thank my own graduate students, Bob Lysak, Earl Witt, and Rachelle Bergmann, and remind you of Chris Russell's encouragement upon receiving the Macelwane award some years ago, that there is still time to accomplish something significant enough to get you to Cincinnati, or wherever the award is presented in the future.

Mary K. Hudson



Raymond Jeanloz

Raymond Jeanloz has made several funda-mental contributions to our understanding of the origin and evolution of the solid earth. His research features a broad and innovative attack upon experimental and theoretical geophysics which combines basic principles from physics, chemistry, and geology. His short career has already included contribute tions to reduction and interpretation of shock wave data, ciremical and thermodynamic models of mineral structures, convection and thermal state of the mantle, phase transitions and petrology of the mantle, and high-pressure high-temperature experiments with diamond anvil cells.

His undergraduate education at Amherst College was in geology, and his graduate edu-cation at the California Institute of Technology (Caltech) combined geology and geophys-ics. Tom Ahrens introduced him to highpressure experimentation and supervised his study of shock effects in lunar materials. This quickly led to a series of studies on anorthosite, anorthite, iron, and olivine. He learned the art of diamond cells at the Geophysical Laboratory of the Carnegie Institution. The brief but intense collaboration combined shock-wave and diamond-anvil experiments to provide one of the first checks of the new ultrahigh pressure calibration scale. About the same time he was also collaborating with Frank Richter in a provocative study of convection in the lower mande. The construction of his own cliamond anvil apparatus led to a series of papers on the effect of crystal structure on mineral properties. His familiarity with experimental data and far ranging interests led to a couple of important review papers on mineral physics, phase transitions,

and general petrology of the mantle. This impressive list of accomplishments in such a young career is a tribute to his capacities for imaginative thinking and tircless work. He has recently established an excellent mineral physics laboratory at the University of California, Berkeley, which allows him and his students to carry out quantitative petrological experiments at ultra high pressures and temperatures by way of the diamond cell and laser heating. Also, his group is combining lattice dynamical theory and vibrational spectroscopy to study the thermodynamic

properties of minerals at a fundamental level. As indicated by those who have been most successful in the past, a broad approach drawing upon several disciplines provides the most promising path to an improved understanding of properties and processes within the earth. Raymond Jeanloz has already made important progress along that path, and, with his versatility, imagination, energy, and youth, we look forward with great excitement to his continued growth as a scientist.

Lane Johnson

### Acceptance.

Thank you for the kind citation. I am deeply grateful to the Union for granting me this award, and I particularly want to note how pleasing h is to receive early in one's career such recognition from colleagues and friends. By the same token, I am delighted to accept the Macelwane Award as a reflection on my own teachers and associates. From

c, John Christie at UCLA, and many others. have been formulate to be drawn into exciting, high-quality science. Also, I owe special debts of gratifude to Dave Mao, Peter Bell, and their co-wockers in Washington, to Suc Kieffer in Flagstall and, indeed, to my present students and colleagues. Much of what do now in my research stems directly from collaborations with these individuals.

In this regard, I leef especially lucky because these are exciting times in mineral physics and experimental geophysics. It is just miw hecoming possible to carry out sophisicated, quantitative studies on minerals at the extreme conditions of temperature and pressure existing near the earth's center. The resulting data provide fundamental insights into the ways in which the planetary interior evolves. At the same time, we are beginning to achieve a basic understanding of the complex solids and lluids that make up this planet. In this area, particularly, I believe that geophysics has much to contribute to the neighboring disciplines of physics, chemistry, and materials science, as well as to the earth sciences. For example, the high-pressure dia mond-anvil cell, which has been developed primarily for genphysical and geochemical research, is now having a major impact in condensed matter research in chemistry and physics. As a result, I believe that there is a very healthy and exching increase in the communication and collaboration between these

I think that this increasing breadth in the area of mineral physics is in no small part due to the unselfish and highly cooperative attitude of our community. I bring this up because the support, the education, and the inspiration provided by this community has been of primary importance to my own development, and I want to take this opportunity to thank my colleagues.

Raymond Jeanlor



John H. Woodhouse

John II. Woodhouse was born in England on April 15, 1949. His academic degrees are from the University of Bristol, where he received the B.Sc. degree in 1970, and from the University of Cambridge, where he teceived the Ph.D. degree in 1975. The world renowned Department of Applied Mathematics and Theoretical Physical was his professional home and John A. Hudson his menter during his postgraduate years.

Must of Woodhouse's early work was concerned with wave propagation, although his third publication on Rayleigh's principle re-vealed his insight and fundamental clarity of thought about low frequency seismology. This work led to his collaboration with F. A. Dahlen and his important publication in 1980 on the coupling and attenuation of nearly resonant multiplets in the earth's free ordin tion spectrum. In that paper one finds the basis for much of today's research on the sub-

After a Fellowship at King's College, Can bridge, and a postdoctoral year at the University of California, San Diego, Woodhoue joined the faculty at Harvard, where heir now professor of geophysics. There he began a fruitful collaboration with Adam Dziewonski that has led to the first threedimensional maps of the structure of the earth's mantle. Like the efforts of the early cartographers of the 14th century, the recent v produced maps of the mantle are certain o be approximations to the truth, containing distortions and misperceptions of various kinds. Yet, they are important first steps of the road to the discovery of the three-dimensional structure of the earth, and Woodhouse's contributions to their construction are profound. Perhaps, as Prince Henry the Narigator improved on the results of the 14th century cartographers, John Henry Wood house will continue to improve on todays.re-

There are many other facets to the pri slonal career of John Woodhouse, such as his work on earthquake source mechanisms, as ymptotic results for propagator matrices. methods for performing seismic calculation Tom Ahrens, George Rossman, and the other faculty at Caltech, to Frank Richter at Chica-freearch on the determination of three discounts.

mensional structure that is the basis for this

Many people of stature derive prestige from the institutions of higher learning with which they are associated. In the case of John Woodhouse he is a Cambridge Ph.D. and a Harvard professor. There are a lew people who, by virtue of their own accomplishments confer status na their institutions. John Woodhouse is nne of these few. Both the University of Cambridge and Harvard University stand higher in geophysics because of the accomplishments and reputation of John H. Woodhouse.

[. Freeman Gilbert

### Acceptance

Thank you Mr. President and thank you Freeman for your very kind remarks. To have to respond on such an occasion places one in a position which is the reverse of what is usual at a scientific meeting. Often one may strongly wish to refute a position taken by a colleague, but not have adequate ammunition. On this occasion I have no wish, whatever, to disagree with the speaker, but I am only too aware of the contrary information which could be brought to bear on the mat-

To accept this award is a singular honor and pleasure, which clerives from the respect in which one holds the previous recipients

and one's colleagues who have conferred the

On a personal level it is an occasion to lonk back and review the path one has traveled. I am reminded of a time when, it seemed to me, my career in geophysics was at an end. Hal Thirlaway was attending a meeting in Cambridge, England, and I was to arrange to have his slides transmitted to the projection-ist. Taking hold of the tray, my hand slipped, and the carefully arranged selection of glass mounted slides was scattered on the stone floor. Many were broken, and their order was completely disrupted. This was also an occasion to admire the professionalism of an esteemed colleague, since he went on to give a most lucid presentation, scenningly imper-turbed by the erratic sequence and evident damage which his slides had sustained. Well, my career in geophysics did not end at that point, though I did find it necessary to emi-

I would like, on this occasion, to express gratinude to friends and colleagues. I wish to thank John Hudson, my advisor at Cambridge, for his advise and support during my graduate student career. At that time I was entirely theoretical, and the pleasure I took in my work was like that of doing a crossword puzzle. From Cambridge I went first to Scripps and then to Harvard, and I would like to thank Freeman Gilbert and Tom Jordan for the important influence they had on my work. Particularly, I express my thanks to

Adam Dziewonski, from whom I have learned vastly more than I knew when I first came to Harvard, particularly with regard to the understanding id seismic data. If the pleasure I took in theoretical seismology was like that of doing a crossword puzzle, it became infinitely more rewarding when Adam

equipped me with some of the class. This award comes at a time when one has just been in the profession long enough to have some perspective and to see the way in which the science evolves. I feel that I have been particularly fortunate to have witnessed the developments since 1975. In the last 10 years we have seen the development of techniques for the calculation of theoretical seismograms, the advent of global, digital instru-mentation, and the growing availability of ever more powerful computers. These developments have set the scene for major new advances in seismology, and, so, to the younger seismologists in the audience I would say that you, as I, could not have chosen a better time

to enter the field. With the new initiatives in global seismic instrumentation and in his hospheric studies, our science is about to enter one of its more exailarating periods, in which quany longstanding questions should be answered. In the words of an esteemed colleague-who may or may not wish to identify himself-"the earth

John H. Woodhouse

# **AGU Membership Applications**

Applications for membership have been received from the Inflowing individuals. The letter after the name denotes the proposed primary section alliliation.

### Regular Members

Spyridon Coubis (GP), Francois Fancher (G), Catherine Gilray (H), Almani R. Jacobson ISA), J. Edward Joyce (O), Benny L. Klock (G). Roger McCoy (GP), Richard G. Miller (O), Glice Keiing Ng (SS), Shangyon Nie (T). Richard Pearson (A), Modia Porba (O), Christos Repapis (A), Ronald Schalla (H), Dorothy G. Swift 10), Charles H. Tang (H), Marthu L. Zirbel (H).

### Student Status

Mark A. Baker (O), Steven Balsley (V), Harold E. Brooks (A), Donald H. Burn (H), Dennis A. Clark (Tt. Cheryl Contant 11f). Robert E. Crippen (TJ, Ken Flon (V), Inge-mar P. E. Kinnmark (H), B. Makinde-Odusola (H), Martin A. McGilvary (T), Biswajit Mukhapailiyay (V).

Clyde E. Rhindes (T), Siephen M. Richard IT), M. Lee Ringland IT), Renneth R. Sperber (A), Hideki Takamiya (V), Elizabeth A. Velz (f), Richard Volkert (V), Jim Warner

# <u>Meetinas</u>

### Announcements

### Risk Analysis

September 18-20, 1984 Risk Analysis in Environmental Health—With Emphasis on Carcinogenesis, Cambridge, Mass, Spansor: Harvard Univ. School of Public Health, (Office of Continuing Education, Dent. A. Harvard Univ. School of Public Health, 677 Huntington Ave., Bostun, MA 02115; tel.: 617-

Among the topics to be discussed are the problem of risk analysis in the context of calrulating risks when data are uncertain; the methodologies for risk evaluation; and the interplay of risk evaluation and risk assessment. mroductory sessions will be devoted to ant overview of techniques for assessing environmental cancer risks. Subsequent sessions will focus on health risks associated with chemical contaminants in the ambient environment and with airborne radon in the environment and the home. Uses mul limitations of epide miology and data from animal studies will be emphasized.

# Petroleum and Natural

September 24-25, 1984 Petroleum and Natural Gas Markets Conference, Calgary, Alberta, Sponsors: Canadian Energy Re search Institute, Calgary Chamber of Con-oterce, [Shane Streifel, Conference Director, anadian Energy Research Institute, 3512 33rd St. NW, Calgary, Alberta, T2L 2Ab. Canada; tel.: 403-282-1251.)

Leading authorities from around the world have been invlted to provide insights on recent and anticipated developments in the world oil market and North American natural gas markets. Topics to be discussed include the outlook for the world oil market; policical uncertainty in the Middle East; the economics of refining and upgrading heavy crudes; prospects for a natural gas futures market; U.S. heavy crude oil outlook; changing corporate strategies; and heavy crude oil

### Geopotential Research Mission Conference

October 29-31, 1984 Conference on Geootential Research Mission (GRM) Science, College Park, Md. Sponsor: NASA. (L. Walter, Code EE-8, NASA Headquarters, Wash-Ington, DC 20546; tel.: 202-453-1675.)

The conference will feature invited and commbuted papers on the interpretation and application of variations in the earth's gravity and magnetic fields on the scales that will be measured by GRM. The subjects of the con-ference are Dynamics and Structure of the Sub-Ocean Lithosphere and the Continents, Mande Convection, The Dynamics of the Core, and Ocean Circulation.

### Lunar Bases and Space Activities

October 29-31, 1984 Symposium on Lu-nar Bases and Space Activities of the 21st Century, Washington, D.C. Sponsor: National Actonautics and Space Administration. (Miduaci Duke, NASA Johnson Space Center, Houston, TX 77058; tel.: 713-483-4464.) The deadline for contributed abstracts is September 3, 1984.

The purpose of the symposium is to explore the rationale, uses, technical requirements, fensibility, and implications of a lunar research base or bases as a long-term objective of the space prugram. Topics of contributed and invited papers will include scientific experiments at a linear base; economic militation of lunar resources; reclandogical feasibility of a permanent base; societal implications and politics of a permanent lase; international conperation in lunar activities; program elements and options; placed development of a lunar base; lunar prover, transportation. and habitation infrastructure; and necessary technological and scientific development.

### Water and Coal

February 26-28, 1985 Second Hydrology Symposium on Surface Coal Mining in the Northern Great Plains, Cillette, Wyo. Sponsor: Gillette Area Groundwater Monitoring Organization. (Ron Landers, Carter Mining Contpany, P.O. Box 3007, Gillette, WY 82716; tel.: 307-682-8881.)

The deadline for abstracts is September 1

The purposes of the conference are to provide a forum for the exchange of information on stirface and groundwater hydrology at surface coal mines in the Northern Great Plains and to present ideas and concepts relating to studies of premining bydrological iditions, relating to predictions of mining related hydrologic impacts, relating to designs of hydrologic control facilities, and re-lating to successful reclamation of disturbed hydrologic systems.

Suggested topics of interest include surface and groundwater monitoring; alluvial valley floors; groundwater modeling; regulations and guidelines; backfill hydrologic characteristics; backfill water quality; stream channel reconstruction; stable postmining topography design; and prediction of site specific and cu-mulative hydrologic impacts.

### **Integral Methods**

March 18-21, 1985 International Conference on Integral Methods in Science and Engineering, Arlington, Tex. Sponsor: University of Texas at Arlington. 1Fred R. Payne, A.E. Dept., UT-Arlington, 76019; tel.: 817-

273-2074.) The deadline for abstracts, (which should be approximately 200 words) is September 15, 1984.

Among the pertinent topics to be covered are analysis; applied probability and statistics; artificial intelligence; catastrophe theory; CFD/computational aerodynamics: theory and numerics; control and feedback theory; discrete mathematics; FEM: analysis and practice; integral and integro-differential equations: theoretic and applied; and micro-processor capabilities and forecasts. The objectives of the conference are to

provide a forum for discussing integral met ods of all types and to bring together workers who use integral methods, including those wno use integral inethods, including those who work in geophysics, astrophysics, biophysics, chemistry, engineering, applied mathematics and mechanics, field theory, continuum and discrete mechanics, organic and inorganic processes, probability and statistics, bioengineering, classical engineering, quantum physics, and transport phenomena for pollutants and contaminants.

## Hydrology Days '85 Call For Papers

Front Range Branch Hydrology Days, Fort Callins, Calo. 11. J. Morel-Seytonx, Dept. of Civil Engineering, Colorado State University. Fort Collins, CO 80523; rel.: :103-491-5448 or

The dearline for acceptance of abstracts for telephone calls) is December 31, 1984, for professional hydrologists, and February 15, 1985, for students.

The AGU From Range Branch is planning three Hydrology Days at Colorado State University, April 16-18, 1985. The objective of the meeting is to provide a forum for hydrolcoists and hydrology students to meet, get acquanted, and bear each other's prolderns. analyses, and solutions. Several special sessions will be held with keynote addresses by

recognized hydrologists. During the 3 days there will be presentations of volunteered papers (mostly), invited papers (a few), and papers by students (on the first day). The time allocated for presentation will depend on the response to this call for papers. Tentatively, the time allotted per paper will be about 25 minutes, including dission. Standard visual aids (regular and

overhead projectors) will be provided. Hydrologists and hydrology students interested in presenting a paper should send a one-page sheet (original plus one copy) with their name, affiliation, complete mailing address, telephone number, title of paper; a brief, double-spaced typed abstract, roughly one-half page long; and an abstract fee of \$10.00 (no fee for students) to the above ad-

Papers missing the abstract deadline may be scheduled for presentation but may not

ing the last week of February and advertised in Eos shortly thereafter, Proceedings of the conference will be published and available at the meeting. Preference on the program will be given to authors who intend to provide a written version (guidelines and special paper will be pravided on request) of their oral presentation. The deadline for submission of the

appear on the program to be mailed out dur-

written version is March 1, 1985. There will be not registration fee for stadents. There will be a small registration fee (between \$20) and \$30) for others to cover room rental lees, coffee breaks, programs, coples of abstracts, and other minor expenses. Final registration details will be availthe when the program is advertised in Feb-

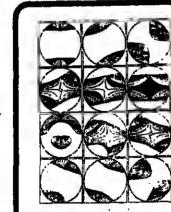
The AGU Front Range Branch will present awards and jurizes to the best student papers in two categories: M.S. and Pb.D. candlifaces At a hundreon, the third award for outstandng contribution to hydrology will be presented. Please send nomination suggestions for this award to Hydrology Davs Award Committee, do H. J. Morel-Seytoux at the above

# Meeting Report

## Archean Geochemistry

A cross section of the Archean crust provided the focus of the 1983 Archean Geochemistry and Early Crustal Genesis Work-shop that convened in Ottawa on August 10, 1983. Forty-six geoscientists registered: 24

Meetings (cont. on p. 454)



# **MAGNETIC** RECONNECTION In Space and Laboratory

Plasmas (1984) Geophysical Monograph Series Volume 30

E. Hones, Jr., Editor \$33

408 pages • hardbound • illustrations

Based on the 1983 AGU Chepman Conference on Magnetic Reconnection, this volume offers a thorough examination of the subject area. A strong balance is made between review papers, those which describe basic principles, and papers on recent theoretical and observational advances. Of special interest is major new magnetospheric observations made by the ISEE 3 satellite. A question and snawer session held during the Chapman Conference as well as an appraisal session are included in the lest section of the book.

ORDER TODAY . . . AQU members receive a 30% discount Orders undar \$50 must be prepsid

Write: American Geophysical Union 2000 Florida Avenue, NW Washington, D.C. 20009

Call: 800-424-2488 (202) 462-6903 (in DC ares or outside contiguous (ISA)

E8128

453

# Handbook of Mathematical Models (1984)

Water Resources Monograph Series 10

I. Javandel, C. Doughty, and C. F. Tsang, Editors 240 pages • softbound • Illustrations

Written in a clear style, this work reviews, selects, and demonstrates the best and most practical mathematical models to predict the extent of graundwater subsurface contamination. Primary emphasis is given to the use of simple formulas and comprehensive tables, resulting in a readily usable guide in the field.

30% Discount to AGU Members

Call: 600-424-2488

(202) 402-6003 (local DC area or butshle configurus USA)

Write: American Geophysical Union 2000 thuhla Ave., NAV. Washington, D.C. 20009

Orders under \$50 must be prepaid

accepted

Meetings (cont. from p. 453)

from the United States, 16 From Canada, three from Australia, and one each from West Germany, the Peoples' Republic of China, and Zimbabwe. The workship was sponstrred jointly by the Gridogical Survey of Canada (GSC), the International Geological Correlation Project (IGCP), the Lunat and Planetary Institute (LPI), the National Aeronauries and Space Administration (NASA), and the Ontario Geological Survey (OGS).

The workshop was divided into an opening rlay ref 16 formal papers, followed by a 6-day field trip. Expanded abstracts of the 16 presented papers and four more that were not esented were included with the 70-page field trip guide given to each registrant."

Vi N

11.

C

1-3

Proceedings gut underway in Alice Wilson Hall at the GSC, where the registratus and a roughly equal number of onlookers from the Ottawa geological community were welcomed by J. G. Fyles (Chief Geologist, GSC). The formal papers dealt with the various facers of the origin and evolution of Archean crust. Jun Wilson (University of Zimbabwe) led off the morning session by providing evidence for correlations between Zimhabwenn greenstone belts. Kent Condie and Phil Allen tNew Mexico Institute of Mining and Technology) discussed and illustrated with beautiful field photos from peninsular India the transition of an Archean granite-greensione terrane into charnockite. Dave Fountain (University of Wyomingt followed with a discussion of crustal cross sections, using the lyrea zone of the Italian Alps and the Archean subprovinces of northern Manitoba as his examples. Werner Weber (Manitoba Geological Services Branch) reported on the relatively felsic Pikwitonei granulite domain of northern Manitoba, interpreted as a lower crustal level exposed at the northwestern end of the Superir province. Lew Ashwal, P. Morgan, and W. W. Leslic (LPI) spoke on a mystifying prob-lem of granulite-facies metamorphism: how to carry supracrustal tocks to great depths, metaniorphose them to high temperatures and pressures, and then reexpose them at the artrface, where they are still underlain by normal thicknesses of continental crust. Roberta Rrightick, now at the Australian National University (ANU), Lew Ashwal, and Darrell Henry (LPI) showed through fluid inclusions structies that CO2 was virtually the exclusive fluid phase during granulite-facies metamorphism of rucks in the Kapriskasing structure. Gil Hauson (State University of New York at Stony Brook), developed the use of olivine and plaginelese saturation sorfaces to place limits on the compositions of cumulate phases

Ross Taylor (ANU) started the afternion aession with an outline of the development of continental crust based chiefly on systematic **charges in the distribution of REE's in line**grained clastic rocks through time. Bob Dyniek (Harvard University), J. L. Boak (Arco), and L. P. Gromet (Brown University), Joblowed by Ullrich Sast (Max Planck Institute, West Germany) presented papers on the chemical evolution of the 3.8 Ga Isua supracrustal rocks in western Greenland. George McGill (University of Massachusetts) then spoke on the tectoric evolution of Venus, pointing to possible onologues with earth's Archean greenstone belts. George Tilton's (Usiversity of California, Santa Barbara) treatment of crust-mantle differentiation, based on the evidence of Pb isotopes, suggested that depleted manife originated about 2.7-3.0 Ga ago in several areas of the Superior. Province. On the other hand, Sm-Nd isotopic

and intetemnulus melts as well as to define

processes of melting in the mantle.

systematics of the Ancient Gueiss Complex of South Africa, and of rocks in the Rainy Lake area, Ontario, as discussed in two papers, respectively, by R. W. Carlson (Carnegie Institution), D. R. Hunter (University of Natal), and F. Barker [USGS], and S. B. Shirey and Gil Hausim (State University of New York at Stony Brook), indicate that zones of depleted mantle existed at 2.7 Ga and probably before 3.5 Ga. Listeners were then vicationally brought back to India by J. D. Macdongall (Scripps, La Jolla, Calif.) and three counthors who discussed a possibly depleted mautle

source under Archeau crust in Raiasthan. The day's last formal paper, by Ken Collerson (ANU), reported 3.9 Ga zircons from the Uivak gueisses in northern Labrador, the oldest ages yet reported from the North American-Greenland landmass. At the prodding of colleagues, Collerson closed the afternoon with an intornual report on work just carried out on the ANU ion microprobe by a number f graduate stridents under the supervision of W. Compston. This work, now in press, determined the existence of zircoos at M1. Narryer, western Australia, between 4.1 and 4.2 Ga old. The "beginning" gets pushed back

farther and farther. The field trip focused on the Kapuskasing structure, a 500-km long curvilinear feature that slices northeastward through the Archean Superior province from the eastern shore of Lake Superior to the Moose River basin near James Bay. The structure was first recognized by Garland [1950], who crossed it on two regional gravity traverses in northern Ontario. He called attention to a belt of positive Bouguer anomalies (the "Kapuskasing-Fraserdale high"), which he attributed to a northeastward-trending band of "thinned granitic layer." Subsequent gravity mapping with appreciably greater station density by In-nes, [1960] succeeded in outlining most of the alructure. Innes suggested that the Kapuskasing-Fraserdale gravity high reflected a major tensional feature of the crust, perhaps not

unlike the East African rift zone. Whereas these early interpretations on the origin of the Kapuskasing structure were pased on a Tensional Tectonic regime, current views lean the opposite way, namely that the structure is a slice of Archean lower continenial crusi, exposed at the surface by erosion following on episode of obduction. By this interpretation, the Kapuskasing structure exposes a crustal cross section 20-25 km thick, eastward from the Michipicoten greenstone belt of the Wawa area, through the Wawa domal gueiss terrane, to the far edge of the Kapuskasing structure at the Ivanhoe Lake cataclastic zone, interpreted as the westwarddipping detacliment surface at the base of the obducted crust [Percival and Card, 1983]. The low-grade Abitibi greensme belt east of the Kapuskasing structure would therefore be correlative with the Michinicoten belt. The progressive increase of metamorphic grade eastward to reach the granulite facies at the Ivanhoe Lake cataclatiic zome (quantitatively traced by various mineralogic geobarometers and geothernrometers [Percival, 1985]), the antifude of basakic dikes. Bonguer gravity anomalies, and the lithologic similarity of the Michipicoten and Abhibi greenstone belts are

are in keeping with the proposed interpretation [Percival and Card, 1983]. The field trip began on Thursday with ah 800-km, all-day ride by chartered bus from Onawa to Sault Salme Marie. The day's geology consisted of brief rescriptions of many roadside outcrops as they whizzed by at 100 km/hr. The first working day of the field irip was Friday when, in the Waws ares, the lower

. 大小海南省沙沙沙

est-grade part of the Michipicoten greenstone belt was examined in road cuts as well as in active and abandoned iron mines. These mucrops provided a baseline for the comparison of relatively untilisturbed characteristics of supracrustal rocks with their progressively more metamorphosed equivalents (or potential equivalents) to be seen thuring the next 2 days. Metasediments, including rouglomerates, a variety of felsic metavolcanic rucks with well-preserved primary textures, mafic metavolcanic rocks which are locally pillowed, oxide and carbonate iron formations with intraformational breccias, and metasomatic(?) chloritoid rocks evoked lively discussions and the expenditure of vast quantities of film. At some outcrops, the clicking of shutters masked the blows of hammers.

Day 2 brought the field trip eastward into the amphibolite-grade Wawa domal gnciss terrane in the vicinity of Chapleau, a vailroad town deep in the bush. Here, participants viewed tonalite gneisses with enclaves of amphibolite interpreted to be partly digested dismembered fragments of Michipicoten greenstone; various granitic rocks disposed in mon meeting at Timmins there came many a series of domes; and, at the day's end, suggestions for research in the field trip area, "granulite" gneiss in the Robson Lake dome and much of this research is either already which shares the structural attributes of the umlerway or planned by the participants, community in collaborative ellorts that were Wawa domal gneiss terrane and the lithological characteristics of the Kapuskasing struc-Ture. Hotly discussed on day 2 were such topics as the significance of the fine-scale and persistent layering in the felsic and intermeiate gneisses, the nature of the protolith for the gneisses, and the mechanism by which

dense mafic gneisses can be incorporated in the upwelled cores of the domes. On day 3, participants were guided easterly through the Kapuskasing structure, past the Ivanhoe lake cataclastic zone, and into the Abitibi greenstone belt beyond, ending up at Timmins. Gneuses in the Kapuskasing structure are relatively more ntafic than those in the Wawa domal gnelss terranc, and many are characterized by interlayers of gneiss with garnet + clinopyroxene + plagioclase and gueiss with hornblende + garnet. Whether these mineralogical contrasts are the result of retrograde metamorphism, Pitato gradients during prograde metamorphism, composi-tional differences in the protoliths or mobilization of partial melts during granulite meta-morphism provided a subject of lively debate among the petrologists. Another provocative subject was. What is the role of orthopyroxene in defining granulite? Two stops in the Shawnere anorthosite complex were particularly impressive. The complex makes up an irregular, lens-shaped, regionally concordant pluton 50 hy 15 km, with a satellite body to the south. Coarse-grained aporthosite, gabbroic anorthosite, and gabbro, in part de-formed cataclastically, elsewhere with corona textures, are the chief rocks. Gray intermediate to calcic plagioclase, garnet, black horn-blende, and orthopyroxene are conspicuous in hand specimens. The Ivanhoe Lake cataclastic zone, not well exposed, was studied in a single outcrop, where make gneiss is sliced by veins of black recrystallized aphanitic mylonite. The Abitibi greenstone belt immediately east of the catachastic zone is made up of fine-grained, layered, east-striking, little-disturbed basahic metavolcanic rocks. The contrast is remarkable between these weakly metamorphosed rocks and the coarsegrained, high-grade, northeast-striking, banded gneisses in the Kapuskasing structure across the cataclastic zone only a few hundred meters to the west. Consistently east-dipping Archean basaltic dikes in the Kapuskasing

upward ramping on an inferred west-dipping Day 4 was spent in the Abitibi greenstone. belt in the vicinity of Timmlns, where numerous metavolcanic and metasedimentary rocks of greenshist and subgreenschist grade were examined. At the first atop, top and bottom criteria were discussed avidly on a bleachcleaned outcrop that exposes an angular unconformity between greywacke and overlying conglomerate. Other stops during the day included altered and pillowed(?) komatities. complex successions of Mg-rich and Fe-rich metatholeittea, excellent displays of variolites. and a complex series of felsic tuffa and brecended eather than previous day in the field to permit a late-afternoon meeting at the motel to discuss plans for future Early Crustal Genesis meetings and to provide written summaries of work underway or planned on the Kapuskasing structure. The results of this meeting are included in later paragraphs. Following a banquet dinner, Larry Jensen (OGS) closed the day's formalities with a talk that illustrated his views on the or-

structure were cited as additional evidence of

igin of Archean greenstone belts based on more than 10 years of his detalled studies of tire Abitibi beli. About half of the participants left the trip at Timmins by air early on day 5. The enthusiasis that remained carried on to see komatiitie and other metavolcanic and metaaedimentary rocks of the Abitibl greenstone belt at Kirkland Lake. "No-hammer outcrops" included komatilite with spinifex texture and metaconglomerate with komatite clasts.

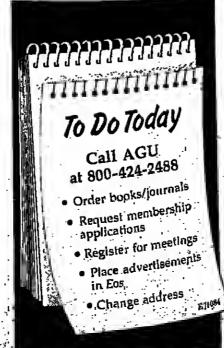
There was an overwhelming concensus that the field (rip focused successfully on the problem under scrutiny. Through a aeries of well-chosen exposures, mostly of excellent quality, the pieces of the Kapuskasing puzzle were viewed in the logical order. Surprising, however, was the limited areal extent of un-

disputed granulites. In part, these rocks are spatially related to the Shawmere anorthome complex, a structurally and petrologically started unit with evidence of having been rransported upward relative to enclosing rocks. Certainly, the presence of granulite-facies rocks in the Kapuskasing structure requires explanation, but their quantitative inportance pales before the thumands of smare kilometers of gramplite exposed elsewhere in the Superior province, the Chruchill province, and the Grenville province. Although the age of the thrusting thought to be responsible for the Kapuskasing structure is known imprecisely, it is no younger than early late Proterozic, and it may be Archean [Percirol and Cord, 1983]. The operation of compressional forces on such a vast scale in not in accord with the commonly held view of the dominance of vertical tectooics in early earth history. Uproming lithoprobe studies in the Kapuskasing structure, particidarly seismic experiments, should provide answers to many questions yet unauswered about this fumlamental crustal learner of the shield.

From the discussions during the late-after

arranged during the workship. Many attend ecs expressed the desire to work collaboratively with others, either within the already proposed ellorts or in new efforts. The suggested research for the area can be grouped into three categories, all of which are necessary for a better understanding of the early evolution of planetary crius: (1) acquisition of basic data. (2) better understanding of processes in the lower crust, and (3) development of models for evolution of the crust-mantle system. The first category includes studies aimed at developing detailed structural and stratigraphic data, complete geophysical characterization on a regional scale, and thorough characterization of the range of rock types (petrography, geophysical properties, and compositions). Such data are required for proper collecting of samples, placing constraints on models, remparison with other areas, and tracing of units dirough the crusal section. The second category includes studies aimed at better understanding of the role of fluids during metamorphism, the products of partial melting in the crust, the evolution of thermal gradients in the crust, the chemical and isotopic changes that develop in supracrustal rocks when taken to the lower crust, and the tectonic rules of various igneous rocks in the lower crust. The third rategory includes studies aimed at determinations of the extent of gen bendeal provinces in the Archean mantle; the chemical and isotopic evolution of the mantle through time; the interaction between mantle-derived rocks and the crust; the history of tretonic, igneous, and metamorphic events in the Archeao; and evdence for pre-Archeau crustal formation. Among the present and planned research

efforts, there are eight in the first category. These range from detailed orapping of the supracrustal meks in the Wawa belt, through refinement of the Kapuskasing gravity data. to measurement of sonic velocities at high P and T for a collection of tacks from the Kapuskasing structure. There are H research elforts involving 17 of the workshop participants in the second category. These range from their inclusion and oxygen isotope state ies across the entire structure for determine tion of fluid interactions, through comparianus of compositions and isotopes between hw grade Michipicoten greenstones and high grade Wawa-Kapaskasing gacisses, to the relations between burolitic to granitic partial melts and their assumed residues in Kapus kasing granulites. There are seven studies in the third category, most of which will utilize some combination of Pb, Sr, and Nd Isotopes in the various igneous and metamotphic rocks of the cross section to develop models for mantle heterogeneities, mande evolution, and crustal contamination.



From the open discussion period there were several ideas that seemed in recieve general agreement. Fiehl workships of this type were considered to be an excellent means of exchaoging ideas, developing new approaches, and coordinating research plans. Furthermore, thematic or process-oriented field workshops could serve as the basis for future conferences or special sessions at regular annual meetings of geoscience organizations.

Special issues or sections of journals could be devoted to papers that resulted from the workshops and conferences. To coordinate these efforts, an advisory group for the Early Crustal Genesis Program should be estab-

lithed to include representatives of other or- Earth Physics Branch, Canadian Ministry of ganizations with similar research interests. This group would develop a long-range schedule of topics, workshops, meetings, etc., to promote coordination and communication and avoid conflicts and excessive overlap. A newsletter containing such information should be distributed to interested persons with some degree of regularity.

Acknowledgments

Parts of this report were taken from another report on this workshop submitted to Geoscience Canada by Tomas Feininger of the

Energy, Mines, and Resources, Ortawa.

References

Garland, G. D., Interpretations of gravimetric and magnetic anomalies on traverses in the Canadiao shield in Northern Ontario, Publ. Dominion Obt., 16(1), 1950. lunes, M. J. S., Gravity and isustasy in north-

ern Ontario and Manitoba, Publ. Dominion Oh: 21 th, 1960. Pereival, J. A., High-grade metamorphism in the Chapleau-Fuleyet area, Outario, Am.

Mineral., 68, 667-686, 1983.

Percival, J. A., and K. D. Card, Archean crust as revealed in the Kapuskasing uplift, Superior province, Canada, *Geology*, 11, 323-326, 1983.

This meeting report was contributed by William C. Phinney, NASAIJohnson Space Center, Houston, TX 77058.

> For detailed information about upcoming AGU meetings, call 800-424-2488.

### Geodesy and Gravity Separates

To Order: The order number can be found at the emil of each abstract; use all digits when ordering. Only papers with order numbers are available from AGU. Cost: \$3.50 for the first article and \$1.00 for each additional article in the same order. Payment must accompany order. De-

> Send your order to: American Geophysical Union 2000 Florida Avenue, N.W. Washington, D.C. 20009

### Electromagnetics

posit accounts available.

OTTO Radio Ocoenography [Theory]
SIMPLIFIED THEORI OF FIRST AND SECOND-DRDER SCATTERING
OF S.F. RADIO WAVES FROM THE SEA
R.E. Rebson (Physics Department, James Coof Univernity,
Toursville, Australie 48(1)
A simplified, physically islutive model of diffuse
scattering of radio waves from a rough ocean surface is
used to derive first and sacond-order cross sections
scentially is eggeneral with standard expressions.
(Scattering, radio waves, sea surface). Mad. Sci., Paper 450945

GP90 Torfreenession and techniques

MR RF-RASED ACRAY SADAR FOR STODYING SHAFL-SCALE
INSCRIPT DY THO MIGH LAYITUDE SONSPREED

8. A. Greenweld (John Mophine Enlwarmit, Applied
Physics Laboratory, Faural, Maryland, 10707), 8. S.
Niter, 8. A. Notchine and C. Manujee

Since Derober, F923, a new coherent bacheceiter
richt has been to operation in Coome Day, labrador,
for the purpose of studying szail-scale election
desting afrocerve in the high Seriated election
desting afrocerve in the high Seriated lonesphere.
This tader operates over a frequency band that extends
from 3-10 Mis and it wens so electeonically phesed
array of 18 fug-pariedic antennas for both transmissice and reception. The rader framenits a 7-pulm
pribers that cambin one for derection 17-ing complex
stoccervalation fentfions of the bachacattesed signalin
is a fuerioe of xange and natural. In this paper we
present a complete description of the phanica serviz,
the techniques of date equicition and analysis an
implemented in the operation of the phanica serviz,
the techniques of date equicition and analysis an
implemented in the rades alcrocomputer, and the
possible on-line and automatic opinering modes that
may be invitic real as a service and the solution of the safer noon and infe evening hours.
These exception is callenged in agree of the hord-diseasional
distibution of sauli-nates attracture and of their
stateohted man Copplet motion. Them Coppler
stateohted man Gopplet motion. Them Coppler
stateohted state from the continue of their
stateohted state for Hoppler spettra derived from the
complex subcourrelation functions. Them Coppler
stateohted state for the spettra derived from the
complex subcourrelation functions. Them Coppler
state for the spettra derived from the
complex subcourrelation functions.

# Exploration Geophysics

Esd. Sch., Peper 450511

5790 Selmio setheds
5 EXIEC OF ROWNOMMIC DESCRIPTION
D. J. Jio (Sellairs Research Laboratoriae,
Termoo hoo, Sellaire, Toras 77807), E. Elemer
The purpose of this paper is to review the
definition, to cutline advantages and
disadrantages, and to present both solved and
usedwad problems, of homeorphic deconvolution are
the advantages of homeorphic deconvolution are
list It does not require the assumptions of a
saldman phase wavelef and of a shift rendon
reflection coefficient serios. Recognised
disadvantages of the method have bee
difficulties in unwrapping the phase, in dealing
with bandliarted signals, and in handling
alted phase reflection coefficient series.
These difficulties may be respectively versoese
by using an "adaptive numerical integration
algoriths," frequency transformations, and
espansotial veighting of the rigical. Two
unvestived problems in homeorphic deconvolution
are deciding the cutoff quefrendes in liftering
convolutional components and eliminaring the
effect of additive reals. So theoretical means
of monvering one scovolutional component of
attributive realof recovering one excelutional component of an arbitrary real selections which is not nectanisated by the other component has been decovered. Additive noise plays as important role to homosophic decoverations so that it is anreliable when the openeral amplitudes of the cignal are very small over certain frequency bands in signals of relatively small cignal-to-noise reflect, (Komosophic decoverabilities, (Komosophic decoverabilities, according to the figure of the cignal and the cignal cignal of the ci ley. Geophys. Epscs Phys., Paper 40889

Geochemistry

1449 Geochmalatry, General Deutrason and Getten 15 in Precipatation; Hoteling of the isotopic expects during show Horation

PROMITION

J. Jours! (DFC/SF; CM; SAGIAY, 91191 Gedex,
Off/Frests, France) and L. Herliver
The classical Rayleigh model sessoning becopic
equilibrium falls to explain the deuterium and
organ 18 contents of polar sense. This model
leads to too high timpserure-feetops gradients
floor for 60 and 8160), to too low 50-5100 slopes
and consequently to an excessively large range of
deuterium-excess values id = 60-55160). We
present a new sodel which sakes late account the
sakisface of an isotopic kinetic effect at snow
former to a to rho fact they were deposition
orders to an excessive pressure and over ice. oreurs too due to the fact ther weper deposition oreurs to anvironment supersaturated over ice. This kissile affect is thoroughly discussed from alcophysical point of view and tested against stylinguished atta and field observations. This new formulation recomplies predicted and observed the formularies reconciles predicted and observed values both for the temperature-lastops and so-joing rejections of appearance of the temperature-lastops and appearance of the temperature of appearance of the temperature of temperat

J. Geophys. Les., D, Peper 400955

1916 SEGIONAL AND LOCAL VERTICAL CREATAL HOWEVERTS
IN MONTREAN PECLAND 1905-1900

8. Torge Insector for Endamentum, Universität Hannover Mienburger Str. 6, D-3000 Hannover II, E. Lanngieser (Kannsterann Sighs, Scheabbordeich 43, 0-2808 ereks, Federal Sepublih of Gersenyl Hannover II, E. Lanngieser (Kannsterann Sighs, Scheabbordeich 43, 0-2808 ereks, Federal Sepublih of Gersenyl Hannover II, E. Lanngieser (Kannsterann Sighs, Scheabbordeich 43, 0-2808 ereks, Federal Sepublih of Gersenyl Hannover II, E. Lanngieser Hannover II, E. Lanngieser II, Scheab II, Sc

J. Geophys. Bes., S, Paper 480862

1950 Beletions of gravity observations to lectorics interpretations of GRAVITY BAYE IS A COMPLEX VOLCANO-TOOLOGY OF GRAVITY BAYE IS A COMPLEX VOLCANO-TO. B. Snyder iu. S. Gaological Burvey, Monlo Petk, taliforcia, 94025 ) and W. J. Chr. A regional gravity study, bested on an irregular 2-km grid, was conducted at Yucch Mountain, soutbuth

A regional gravity study, bessed on an irregular 2-tm grid, was conducted at Yutch Hountain, soutbuth Mys County, Navada, see part of B program to insele a suitable teppository for high-level nuclear waste. About 100 eurisca-rock mappies, throe borchole gamma-gamma logs, and one borshole gravity study provide sagilant density control. A nearly linear increase in density of 0.26 g/cm per km of depth is indicated in the thick tuif sequences that underlie the mountain. Isostatic and 2.0-g/cm bougher corrections were applied to the observed gravity values to rumove regional gradients and spographic effects, respectively. The Care Hountain gravity high, with an isometic anomaly massimon of 88 mids, is connected with a greater high over the Fanaral Mountains, to the southwest; injuster, these highs result from a continuous slock of dense, maismorphomed from soft lock of dense, maismorphomed from soft lock of dense, maismorphomed from much of the Busher Lene from the east adge of Death Valley to Bare Hountain. Yalf, or lanel forth this. Still. Scills and from the thick tall section are within a Large collapse area that includes the Craiser Flat. The gravity los and the thick tall section are within a Large collapse area that includes the Craiser Flat. The gravity loss in Craiser Flat Itself are local calders complexes. Southward extension of the broad gravity loss in Craiser Flat Itself are local calders complexes. Southward extension of the broad gravity loss and the craiser flat tuff, these graves add mastry 300 km² to the previously resognized extension of the broad gravity los associated with Grater Flat Into the Amargens benefit Indicates that macrocragament processing associated with Grater Flat Into the Amargens benefit Indicates that macrocragament process of collapse agreement related to the formation of the trood gravity loss and actions and the collapse agreement related to the formation of the two of the formation calders are mapping and the collapse agreement related to the formation of the trood process

J. Leophyn. Res., B. Paper 48u?e2

### Geomagnetism and Paleomagnetism

2598 Donoral Recomments Floid Modellings

2798 Conoral Rocengeric Floid Modellingi
EPHRECAL CAP RARMONIC CRALVEIS
O.Y. Malose IERATh Physics Branch, Energy Mines
and Rosserces Ceneda, Oliswa, Ontatio, Cacade,
KTA 6733
The modulice of Laplace's Equation, is spherical
coardinaton, is developed from the benefar raive
problem appropriate to fifting five generalize
fleid over a spherical cap. The acturion involves
associated begener functions of integral order
but son-infogral degree. The bashs functions
compiles two loffells mets, within each of which
the Functions are measurily orthogonal. The socien
for the expansion of the potential can by design
but differentiated there by team to glad actionally
convergent series for the Tield components. The
section of decoautasted by modeling the 1979 1980
at the certain for the Tield components. The
section of decoautasted by modeling the 1979 1980
at the certain action of the potential can by design
but if the sapid, and standard errors of fir as low
as the order of a manolenia can be obtained wife a
semanolation number of contributes. Operate
continuation suffress from not confidency wife in
semanolation cap the deceloration belog continual
for the boundary at low continuation attifeder bet
approach on the cap with issuessing
mittudes. At 500 km, the mandard error of
upward continuation cap by settreation from data
from the whole carts. Ipotential Field specialing
apherical hermonic enalysis, upward continuation.
J. teophys. Res., B, Papet 480381

Hydrology

J. Geophym. Res., B, Papet 480981

Veter Resour. Las., Paper 440908

SIJO Groundwatar

WYSTRADY SHALLON GROUNDWATER FLOW OWER A CURVED IMPER
HEALE SOURCASY

T.O. Chapman Bohool of Givil Engineering, University

New South Wales, F.O. Oox 1, Emmington 1003, Amered

and R.T. Bressler.

The symphotic method which produced the new Bressler

equerion for curved open-shannel hydraulist flow has been

employed to obtain maniques equations for unontendy, to

dimensional, frac-on-prises groundwater flow over

an arbitrarily curved bed. The result is a pair of

pertial differential equations, the first incer,

exemming from Darray's Law, the second monitons, exprai
ing mess conservation. The hydraulia conductivity and

porneity can be functione of position. The flow one
porneity can be functioned in position. The flow one
porneity can be functioned in position. The flow com
porneity can be functioned to position. The flow com
porneity can be functioned to position. The flow com
porneity can be functioned to be behaves as a verter

in the wall with the activities a decaderation, but with the

cantrilogal term in the promute. For the special case

of a plane eloping bed, the neumations reduce to the

fooding-Chapman axtension of the Deputit-Forchhalmer

equations the special case of a non-instropic median

gant all med to a special case of a non-instropic median

and to include the effect of 1 variable recharge rata.

Alf the systems are parability, these describing diffusion

and can be integrated non-ricality as readily as the

simpler equations for plane beds. (onconfined, poroun

readia, hydrewlite, haput-Fatchhalmer).

Water Rescur. Lam., Faper 40908

Lead 210 and Polonium 210 in Mount St. Helens Ash (Paper 480542) Reflectance Spectrescopy: Quantitotive Analysis Techniques for Romoto Sensing Applications | Paper 480270)

Rager N. Clarl and Ted L. Roush Spectral Properties of Ice-Particulate Mixtures and Implications for Remote Sensing. 1, Intimate Comment on "Observations of Volcanic Tremor et Mount St. Helens Volcano" by Michael Fehrer 181731;

Michael G. Ferrick and William F. Sr. Lowrence
Comments on "The Byidence of 'CHOI' in Sediment Core Samples of Pacific Ocean Collected Among FGOE" by

Journal of Geophysical Recearch

	Volume 89	Number B	7 July 10, 1	984
cial Section: Fault Behavior and the Earthquistion to the Special Section on Fault Achavior and the Earthquisti	ueke Gen Generation Pro-	eration P	rocess (0650)	
A. rthquake Naformation Cycle, Recurrence, and the Yeme-Predictable	evin J. Copperi Model (Paper	3 <b>8 (8</b> 0%)		3669
Behartor and Characteriate Earthquakes: Examples From the Wasa tes 1Paper 4806111		dreus l'nob	yne Thak bet	5674
ch on the Geometry at Shear Fractore Zones 1Paper 4B07741	avid P. Achwar			5681
Formation Along the Bocomo-Moron-El Palar Fault System, Venezu		r Qidong and Z 04171		3699
oring Velocky Variations in the Cross Urling Earthquake Doublets: A		n the Culatern		5711
face Extensional Tectonics of the Hastern Hustin-Runge: Interences o ba. Regional Tectonics, and Thermal-Mechanical Models of Hrbrie-	Jucide Debrina	le From Selsm (m) - (Paper 40	re Arderston SN6137	5719
ns and Timing of Laie Quinternary Caulting in the Circat Usein Provi ntures - 1Paper 4800571				5761
eation of Ware-Cut and Faulting-Cuntralled Landborns Waper 4b Thomas V. Hanks, Robert C. Buskaan	WIGH			3771
men of the Buse of the Soismogenic Zone: Contributing Unclose 11			ard II Sibson	5791
tale of an Introcrustal Asthetosphere on the Dehavior of Major Strii ultr (Paper 480181)	ke-Slip D. L. Janotte .			\$801
is of Physical Fault Properties on Enctional Instabilities Produced o olts - (Paper 486999)	<ul> <li>Simulated</li> </ul>		es II Ductorich	5817
ification of Moment and Strain Energy Release that to Interaction to ones (Paper 181725)	tarween Offerer Cuchnell, K. Hn	of Size Louis Si	lir.	4H2K
oic Analysis of Fault Ship Data Sets (Paper //BOS09)	(Walmixi. K. Fin		n gues Anceles	5815
hysical and Geological Evidence for Fracturing, Water Circulation ( djacent to Major Strike-Ship Fault) - (Paper 480414)	sod Chemical A	liculion in Gra	mine Rocks	5844
ne Constitution of the Sun Andreas Cault Zone in Central California	(Paper 4HUL7	41	old I Steeman Dastaon Wany	4×4×
rities, Barneri, Characteristic Farthquakes and Strong Motion Pred	Siction (Paper		Kente 1ke	4867
ismotections. Analysis of the Auga Seising Unip. San Justito Unift.	Zone, Southern	California (Pa		4824
int Seismicht, Variations and Aspertius in the New Hebrider Seismi	ic Zone (Doper	30 <b>0</b> 000 #.	E Habermann	.4491
arang service and society and service transporting Cartinguakes for the applicable alternation (1983-2003). (Paper 410-00)			art P. Stylicako	Sons
guier Section ping the Lower Manile Determination of Lateral Hererogenesty in A			del 1. Talvalue	
rder 6 (Paper 4B0430)		Adam	W. Percususki	\$929
ping the Upper Mooste: Three-Humansiumal Modeling of Earth Struc Vareturms - (Paper 480010)	lure by <b>le</b> vellid Iodai II. Waadhi		M. Dziekowski	4953
d Anomelies in a Dynomic Earth (Paper 480594)	Mark A Ric	hash and Bro	fjord H. Haver	\$987
lucted Slobs and the Geoid: Constraints on Mantie Rheology and Fl		errati	ford H. Hoger	1004
physical and Isotopic Constraints on Mantle Contection. As Interim	Synthusis 1Pa	ries. Pet +notom	they F. Davies	40 <b>1</b> 7
omot Date for Pyrrholite and the Earth's Core Paper 4803581  1. Un hael Brown Pacific Ripe From Signification to Orozco Fracture Zonns: Along-Sirik	e Continuity of	rens, and Denn Axial Neuroles	is L. Shampine into Zone und	MHI
Pager 1	MOTTA raid. Jean-Cirrin		, and P. J. Fox	6049
he Pacific (Paper 4B0398)	O . Marth. J. G.	Marsh, and R	G. Williamson	6070
in) Faulting and Microearthquekes of the Intersection of the Verna F idge 1Paper 4801951	Heeb A	owlets and Dev	uld W. Feresth	4079
pressional and Shear Wave Structure of the East Pacific Rise at 11° lecan Bottom Selsmometer Data 1Paper 4B04481	Ster en	R. Brutt and Si	component	6095
eture and Verlability of Oceanic Crust on the Flanks of the East Pac 3°N   Paper 480450/	Su	rsen R. Brass u	nd G. M. Pursly	6111
logic and Selemic Velocity Structuru of the Crust/Maptle Transition Complex 1Puper 4B05221	J. A. Kurson.	J. A. Collins.	and J. F. Canev	6126
onic Implications of the Microearthquake Seismicity and Fault Plan F. Grange, D. Honfeld, P. Cunningham, P. Hulnar, X. W. Ra- ocentral Trend Surface Analysic: Probing the Ocometry of Benioff A	Zones i Paper 4	2. A. Kearque B0356)	•, asu L. (#01a	6139
Geometry of Back Arc Thresting Along the Eastern Sunda Arc, Inc Provity Data (Paper 480341)	Jonesia: Constr	dots From Eart		6153
omparison of Velocity and Attenuation Retween the Nicobar and Bear Engl 180411/	engal Deep	_	nd John Näbelek	6171
R. Cle of Atlenuation on Refiretions: Experimental Tost 1Paper 419039	951	Thierry Bombi	and Michel Rée è and Amor Nur	6180 6197
iling Associated With Large Earthquakes and the Average Rate of I Asia (Paper 4B0046)		Centrol and Eas	stem nd Deny Qidong	6203
nent-Magnitude Relations in Theory and Practice (Paper 480432)			Thorid M. Boore	6225
in Accumulation Across the Asal-Ghombbet Rift, Djiboutt, East Afr	ica 1Paper 4B0	H511	and J. C. Lépine	623
lem Uparching of the Ouff Coastal Plain   [Paper 4B0463]	g.	Jurkanski, J. N	Vi, and L. Brown	6247
ck Rotation by Strike-Slip Faulting: Structural and Poleomegnetic E	Videges (Pape	t 4B0329t rund, Z. Gerfyl	nkel. and A. Nac	625
omagnetism of Abbott Seamount and Implications for the Latitudin	el Drift of the I	lawaiian llot		

A Method for the Display and Analysis of Transitional Paleogragnetic Data 1Paper 4B05390

Peng Han-Chang, Zhao Kul-Huan, and Chen Sul-Tion (Paper 480082)

Paters : sies of Sulfus and Chlorice Yield to the Almosphere Frum Volcanic Empilons and Potential Climatic

J. D. Oerine, II. Sigurdsson, A. N. Darin, and S. Self

Roger N. Clark and Poul G. Lucey

454

A. E. Nechtl

B. P. Glass

Peng Han-Chong